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ABSTRACT

This report explores Federal policy options regarding student, research, and institutional support in the environment of graduate education. Emphasis is placed on a brief history of Federal support for graduate education and research, pressures and problems facing graduate education, graduate student support, Federal policy toward academic research, institutional support, and coordination of Federal policies toward graduate education and research. A supplementary article concerns the difficulties in cost analysis of graduate education. The appendix presents statistical tables. A 59-item bibliography is included. (MJM)

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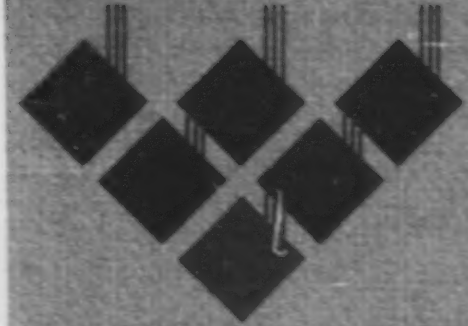

Federal Policy Alternatives toward Graduate Education

A Report with Recommendations of the

NATIONAL BOARD ON
GRADUATE EDUCATION

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
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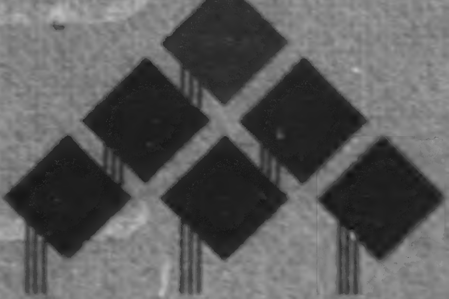

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Foreword

Higher education in the United States has had widespread public attention in confronting the issues and problems that have emerged in the recent period of financial stress, changing attitudes and new demands. Evaluation of its purposes and performance, the need for change in its service and policies, and how best to arrange its priorities for resources and effort have been the subject of reports by commissions and task forces and by research specialists and analysts. These aspects of higher education have also been the subject of extensive commentary by lay observers, including public officials and the press.

It is apparent from this extended public discussion, that the significance of graduate education as a national resource is not generally understood. The role of basic research, as conducted in colleges and universities—and the public benefits from that research to the economy, to the culture, and to individual and social progress—merit wider public recognition and attention than now exist. The interaction of graduate education with the other elements of higher education and the urgency of the present condition are not generally appreciated.

In 1971, recognizing the need for a thorough analysis of graduate education and its relation to American society in the future, the Conference Board of Associated Research Councils* established the National Board on Graduate Education (NBGE) to undertake the task of preparing studies and making recommendations.

In its first report (November, 1972), NBGE presented its view of the fundamental purposes of graduate education and identified the problems and concerns that would receive high priority among its agenda. First among these was a critical review and analysis of issues pertaining to the labor market for highly educated persons, since understanding of that complex subject is central to informed policy formulation for graduate education in general. Accompanying this discussion in the second report (November, 1973) were a number of conclusions and policy recommendations.

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* Composed of the American Council on Education, the Social Science Research Council, the American Council of Learned Societies, and the National Research Council.

The present report, *Federal Policy Alternatives Toward Graduate Education*, is intended to be useful to those who are charged with responsibility for recommending and formulating proposals for United States congressional and executive approval. The report sets forth NBGE's view of the federal interest in graduate education and contains specific suggestions for action.

Additional reports on other topics of immediate and urgent concern will be issued as prepared. The final report of NBGE is planned for mid-1975.

ACKNOWLEDGMENTS

In preparing the present report, NBGE had the advice and leadership of a task force of eminent consultants. Four of the ten members (Frederick E. Balderston, Howard Bowen, Robert Hartman, and Joseph Kershaw) served as authors of sections of the draft submitted to the Board. The Staff Director of NBGE, David W. Breneman, served as contributing author as well as general editor, with Sharon Bush, Staff Associate, and Robert Snyder, Research Associate, of NBGE also contributing sections of the report. A number of authorities in the field of graduate education reviewed earlier drafts and assisted the task force with their insights and criticism. The task force members were as follows:

Robert Alberty, Dean, School of Science, Massachusetts Institute of Technology
Frederick Balderston, Department of Business Administration, University of California, Berkeley
William Bouwsma, Department of History, University of California, Berkeley
Howard Bowen, Chancellor, Claremont University Center
Robben Fleming, President, University of Michigan
Norman Hackerman, President, Rice University
Robert Hartman, Senior Fellow, The Brookings Institution
David Henry, *Chairman*, National Board on Graduate Education; and Professor of Higher Education, University of Illinois
Joseph Kershaw, Provost, Williams College
Frederick Thieme, President, University of Colorado

In addition to the members of the task force and NBGE reviewers and staff, Harvey Brooks of Harvard University, W. C. Kelly of the National Research Council, and Charles Kidd of the Association of American Universities gave extended time as well as helpful commentary.

The several drafts and the final manuscript were prepared with the typing and editorial assistance of Renee Licht and Mark Nixon of the NBGE staff.

The budget for the present report was underwritten by grants from the Ford Foundation and Carnegie Corporation of New York.

General financial support for the National Board on Graduate Education has come from: Carnegie Corporation of New York, The Ford Foundation, The Andrew W. Mellon Foundation, the National Institute of General Medical Sciences, and the National Science Foundation.

David D. Henry, Chairman
National Board on Graduate Education

January 1974

Preface

Dramatic changes in the environment of graduate education during the last five years, coupled with rapid shifts in federal policy concerning its support, make development of sound federal graduate education policy for the balance of the 1970's an extremely challenging task. Although the National Board on Graduate Education had been engaged in active debate on many aspects of this subject, it was only after a decision was made in July 1973 to prepare the present report that the topic was given the concentrated attention it requires. A few comments on the evolution of this report may be helpful.

At the first task force meeting, those present decided that the report should focus on immediate issues of federal policy without trying to resolve the broader questions of how graduate education and research in all their aspects should develop in the next several decades. It was agreed that a careful rethinking of the immediate policy options regarding student, research, and institutional support would be more valuable at this time than an exercise in futuristics.

Although the report was to explore federal policy options, the task force decided not to analyze such extreme "options" as total federal financing of graduate education or total withdrawal of all forms of federal support. We chose instead to focus on the realistic policy issues of incremental resource allocation, rather than on radical departures from existing patterns of support.

The authors were asked to concentrate on basic principles in their analysis without limiting their discussion to existing programs and legislation. For this reason, we did not prepare an exhaustive survey of existing federal programs that provide support for graduate education and research. Consequently, the absence of a recommendation regarding any particular program should not be construed as a lack of endorsement.

For the purpose of this report, graduate education is defined as those programs of study that lead to an M.A., M.S., Ph.D., or other doctoral degree, which are ordinarily conducted under the supervision of graduate schools. This definition includes postbaccalaureate study in such areas as the natural sciences, humanities, social sciences, fine arts, education, engineering, nursing, and the basic medical sciences. It also includes postdoctoral study in these same fields. The definition excludes programs in professional fields such as medicine, law, or theology. Although these distinctions are not always sharp, they are consistent with the broad areas of NBGE concern.

Throughout the report we adopted the shorthand of referring to Title IX–Graduate Programs, of the Higher Education Act of 1965, as amended in Title I of the Education Amendments of 1972, simply as Title IX of the Education Amendments of 1972. This should not be confused with the actual Title IX–Prohibition of Sex Discrimination, of the 1972 Act.

David W. Breneman, Staff Director

2101 Constitution Ave., N.W.
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January 1974

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1 Conclusions, Recommendations, and a Positive Program

CONCLUSIONS AND RECOMMENDATIONS

1

Graduate education, scholarship, and research occurring within the nation's universities are of immense significance for the scientific, economic, and cultural development of the nation. The flow of new knowledge developed through basic research, coupled with the advanced education of individuals that enables them to contribute new knowledge and apply the research findings, are essential to such basic social concerns as eliminating disease, feeding the world's population and controlling its growth, developing new sources of energy, controlling environmental pollution, maintaining the competitiveness of our industries, understanding and alleviating problems of urban life—including housing, mass transportation, and racial tension—and expanding our knowledge and understanding of history, government, economics, art, music, and religion. There is hardly a sphere of life that is untouched or unaffected by graduate education and research, although the universities that perform these activities are only a small percentage of the approximately 10,000 institutions of postsecondary education. The continuing contributions to society that can be expected from graduate education and research indicate a clear national interest in ensuring their continued strength, vitality, and flexibility.

In addition to their value to society, graduate education, scholarship, and research are of central importance within the university. The most basic task of the university is *learning*, in the sense of transmitting the known and discovering the new. The unity of the university derives from its commitment to learning, which is the foundation of all its activities, whether in undergraduate education, graduate education, research, or public service. Graduate education and research are not mere appendages to the university, but are instead its defining element, infusing a spirit of inquiry and a concern for scholarship throughout the institution.

2

The nature of graduate education and research requires the federal government to assume a central role in financing these activities.[1] The labor market for highly trained scientists and scholars is national as well as local and regional. Knowledge is part of the public domain and the advancement of knowledge is of national or international consequence. *Neither the private market nor local areas or states can be expected to bear the whole burden of financing graduate education and research when the benefits are diffused so widely.*

The federal government also bears a special responsibility for graduate study and research because of its broad obligation toward the economic and cultural development of the nation, which is heavily dependent on highly trained and broadly educated people and on the cultivation of knowledge and the arts. The federal government, moreover, employs the services of a large number of scientists and scholars, both directly and indirectly, and therefore has a special interest in their education. The federal government is the only agency that can redress inequalities and imbalances among geographic regions in the availability of facilities for graduate education and research, which are of great importance in regional development. Finally, the federal government is the agency best equipped to deal with economic inequalities among persons that affect opportunity for advanced study. The graduate schools with their educational and research programs are a *national resource* of the first order, and the role of the federal government in their maintenance and advancement is critical.

3

The stress placed on the importance of federal support for graduate education and research in this report does not mean that federal aid should replace either private giving or state support. The $1.6 billion in private gifts to colleges and universities in 1971–1972 is a central and indispensable source of revenue for many institutions, and provides the margin for excellence in

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[1] National Science Board, *Toward a Public Policy for Graduate Education in the Sciences* (Washington, D.C.: U.S. Government Printing Office, 1969), p. 37.

many others. It is not only the amounts of private gifts but the fact that they provide a countervailing force for state and federal funds that is important. With regard to state support, the federal government cannot be expected to assume responsibility for the basic institutional support of state universities. Accordingly, the health of the important publicly supported segment of graduate education depends decisively on the basic state appropriations for the public universities. No foreseeable change in the purposes or amount of federal support will change this basic dependency. Indeed, the trend toward specific state support of private graduate education, developed most notably in New York state, points toward an expanded financial role for the states.

4

Federal support for basic research in universities and for graduate students grew rapidly from post-World War II until 1968. In the last five years, however, funds for research have declined slightly in constant dollar terms while federal fellowship and traineeship support has fallen dramatically from over 50,000 students supported in 1968 to a projected 6,600 in FY 1974.[2] In addition, several federal programs that provided semicategorical institutional support linked to graduate education and research have been eliminated or are being phased out. (For details, see Chapter 2 and the Appendix Tables.)

In retrospect, it is clear that the rapid growth of federal support, particularly in the early and middle 1960's, could not have been expected to continue. However, the rapidity and severity of federal cutbacks in the last five years will, if continued, undermine the nation's capability for high quality graduate education and research. A reassessment of current federal practice for the purpose of developing a sound federal policy oriented toward the requirements of the 1970's is clearly called for.

5

As the graduate schools adjust to the changed circumstances of the 1970's, national efforts should be directed toward achieving the following goals:

- *Enhancing the effectiveness and efficiency of graduate education, scholarship, and research.*

Strengthening the national structure for graduate education, scholarship, and research by supporting strong programs currently in existence in all regions and ensuring that the most talented students are not denied access to these programs.

[2] Federal Interagency Committee on Education. The 1974 estimate is based on the FY 1974 budget, not final appropriations.

Discouraging the proliferation of graduate programs, while ensuring that universities have the necessary resources to develop programs in new fields of study and to meet new social needs. In a period of limited resources for higher education, careful review and elimination of weak graduate programs is one potential source of the resources required for such new programs.

Ensuring that the supply of persons with master's, professional, and doctoral level education is in reasonable balance with the long term demands of a complex, technological society.

Sustaining a flow of new research findings, basic and applied, required for both the cultural and material well-being of the nation.

Protecting the freedom and the adaptive capacity of the nation's universities.

- *Ensuring the responsiveness of graduate education to the needs of society.*

Ensuring that graduate education contributes to the national commitment to eliminate discrimination based on race, sex, age and socioeconomic status.

Stimulating changes that will encourage the most effective contribution of graduate education and research to the solution of urgent national problems.

Encouraging responsiveness to the needs of students, including the development of graduate programs that serve part-time and older students, as well as the needs of urban residents.

Realization of these goals is complicated by several problems and unresolved issues currently facing graduate education, including:

Labor market prospects for doctorates Although we reject forecasts of an impending "Ph.D. glut," graduate schools do face major adjustment problems to a changing labor market (pp. 27–29).

Financial pressures Marked reductions in federal government support for basic research, graduate students, and graduate institutions in the last five years threaten, if continued, to erode the quality of graduate education and to undermine the nation's research capability (pp. 29–36).

Access to graduate education Although it has not become national policy to guarantee access to graduate education, certain invidious barriers that have operated to restrict access for minority group members, for women, and for older students must be eliminated (pp. 36–40).

Planning, management and cost analysis Improved management of resources is imperative for all higher education, including graduate education and research, but the current interest in developing unit cost measurements poses a particular problem for graduate education because of the interrelated nature of "inputs" and "outputs" (pp. 40–41).

Adjustment problems to the steady state of the 1970's After more than a decade of rapid growth, graduate education faces a prolonged period of slow (or no) growth, which poses such problems as determining the "proper" national distribution of resources (geographic dispersion versus concentration), maintaining the vitality of the disciplines in an era of limited faculty expansion and turnover, and ensuring that the adjustment process to reduced federal support is directed toward the goals outlined at the beginning of this section (pp. 41–44).

The lack of coordination among federal policies toward graduate education The absence of coordination and stability complicates the planning process for universities, and has become particularly severe in the recent period of abrupt change in many federal policies affecting graduate education (pp. 44–45).

6

Recent shifts in federal policies toward graduate student support have significantly reduced the number of students supported by federal fellowships and traineeships and increased the number for whom self-support and loans are the major source of financing. The basic policy question is whether, and to what extent, these trends should be continued.

In our judgment, the benefits of graduate education are both private and social, accruing to the individual student and to the state, region, and nation. This argues for pluralistic sources of student finance, with fellowships, traineeships, teaching and research assistantships, loans and family resources, and subsidized tuition all playing a part.

For the 1970's we endorse the following principles for graduate student support:

- Graduate tuition should be maintained at levels below the "full cost" of graduate education in recognition of the broad social benefits that result from graduate education (pp. 47–48).
- Assuming no major increase in graduate tuition, federal fellowships and traineeships should *not* be increased to their 1968 highs. Neither should they be totally phased out, however, which is the direction of current administration policy. Three specific rationales for specialized federal fellowship and traineeship programs appropriate to the foreseeable needs of the 1970's lead to distinct federal programs for support of graduate students (pp. 49–54):

Merit fellowships A limited number of portable fellowships, awarded in national competition on the basis of academic merit, to be used for doctoral study in any academic discipline. These fellowships would be designed to recognize individuals with outstanding intellectual potential and to ensure that no financial obstacles prevent them from attending graduate school. The number of awards should not fluctuate in response to labor market conditions.

Specialized manpower and research programs National programs which provide traineeships to support students (or postdoctoral researchers) in new programs oriented toward such urgent social problems as energy supply, conservation, and distribution; health care delivery; and the manifold problems of urban life, including housing, mass transportation, and racial tension. In the absence of traineeship support, the trained manpower and research efforts necessary to work toward solution of these national concerns will not be forthcoming in adequate number, quality, and time. The traineeships would be awarded by the institution (laboratory, institute or department) responsible for the program, and the students would use the award only at that institution. The number of awards should be adjusted to the best possible estimate of future manpower and research requirements in the special areas, and would have strict time limits, subject to review.

We strongly endorse recent United States congressional action in appropriating funds for FY *1974 to continue the National Institutes of Health/National Institute of Mental Health* (NIH/NIMH) *training grant programs.*[3] These programs incorporate many of the objectives in the areas of biomedical research and health care of our proposed program.

Minority group program A program to promote participation in graduate education for historically disadvantaged minority groups will be specified in a forthcoming report. Provision of financial support for minority group students will be a major part of the program.

A specific proposal for funding levels of two of these three programs is contained in the final section of this chapter.

- At this time, federal fellowships specifically for the purpose of stimulating additional students to prepare for academic careers are not required. For this reason, and in light of the more essential fellowship and traineeship programs recommended above, we do not recommend funding for the fellowships authorized under Title IX, Part B, of the Education Amendments of 1972. The authorization for these fellowships should not be allowed to expire, however, since funding of these programs may be necessary if other sources of student support prove to be inadequate (pp. 54–55).

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[3] Due to the recent passage of the FY 1974 appropriations bill for the Department of Health, Education and Welfare and the Labor Department (complicated by changes in budget categories, impoundment uncertainties, and administrative provisions), the precise allocation of funds to the NIH/NIMH training grants program and the NIH general research support program remain unclear at this time. Reference to current support levels of these programs throughout this report should be regarded as tentative until final verification.

- A national program of grants for graduate students based on financial need and modeled on the undergraduate Basic Opportunity Grant is *not* endorsed, for both philosophical and practical reasons (pp. 48–49).
- Research and teaching assistantships are assumed to be important continuing sources of graduate student support.
- Loans should continue to be a significant component of a total plan for graduate student support, but there are limits to the utility of loans. In individual cases, loans should not be so large that highly capable students are discouraged from undertaking graduate work. Several technical problems, moreover, in the terms, conditions, and administration of existing loan programs prevent their expansion much beyond current levels. These problems are sufficiently difficult that substantial analysis, debate, and negotiation will be required to resolve them. Consequently, policymakers should not expect existing loan programs to continue to take up the slack caused by reduction of other support programs (pp. 55–60).
- The Education Amendments of 1972 should be amended to increase the individual loan limit from $10,000 to $15,000, and to extend the repayment period from 10 to 20 years. Experimentation by individual universities with variable annual loan repayment schedules and with methods for taking financial need into account should be encouraged (pp. 58–59).

7

The national research effort is conducted in universities and colleges, private industry, government agencies, and in various specialized research institutions. The emphasis in universities is primarily on *basic* research (as contrasted with applied research and development), and most of the nation's basic research is conducted in universities. The federal government provides over 60 percent of the funds for all basic research in the United States, and over 50 percent of federally funded basic research is conducted in universities and colleges.

The process of graduate education is inextricably linked with research, since most doctoral programs (and many master's degree programs) culminate in independent research, i.e., the dissertation. In many fields, graduate students serving as research assistants make important contributions to the production of research. Moreover, to be effective teachers, faculties must themselves engage in active scholarship and research, particularly at the level of graduate education.

The essential place of research in graduate education, and the central importance of the federal government in supporting basic research in universities, make federal research policies of utmost significance to graduate education. Unfortunately, there are no clear-cut guidelines for determining the "optimal" scale for the national effort in basic research. Growth at the rate experienced in the early 1960's (average annual increases in excess of 15 percent) could not be maintained forever; on the other hand, restricting basic research to what was essentially no growth in real terms, as in the last five years, seems unwise as a long-term policy. Our nation—and the world—face many serious problems relating to economic productivity, the environment, energy, resource depletion, the cities, health services, education, poverty, unemployment, inflation, international affairs, crime, and social morale. To solve most of these problems, research in the physical sciences, social sciences, and humanities is needed, and highly trained professional people are needed who depend on a research environment for their education. It is unlikely that the present level of support for basic research is too high; on the contrary, there are indications that it may be too low.

The report advances two recommendations:

- Federal funds for support of basic research should grow, *at a minimum*, at the same rate as the growth of the gross national product (GNP) (pp. 67–68).
- To implement the first recommendation, whenever the federal mission-oriented agencies shift priorities and reduce their support of basic research, the research budgets of the National Science Foundation and the National Foundation for the Arts and Humanities should be increased by offsetting amounts in order to maintain stable and moderate growth of total federal support for basic research (pp. 67–68).

B

Federal support of graduate education and research has been concentrated on financial aid to students and categorical grants for research and training programs. Broader institutional support has been provided largely by states, by private giving, and by student tuition. Although this federal policy of specifically targeting support for graduate education and research has sometimes worked against the development of the universities as coherent and balanced institutions, *we believe that the division of responsibility for higher education which has been evolving over the past 25 years is fundamentally sound, namely, that the states and the private sector assume responsibility for basic operation of the institutions and that the federal government assumes increasing responsibility for the financing of students,* *research, and selected institutional programs in the national interest.* The federal government has provided semicategorical institutional aid in the form of cost-of-education allowances accompanying fellowships and traineeships, supplemental aid accompanying research grants, development grants, and grants and loans for buildings and equipment—but most of these programs have been substantially reduced or phased out.

We recommend the following program:[4]

- Cost-of-education allowances accompanying existing and recommended federal fellowships should be continued and increased in amount to reflect the rapid cost increases that have occurred in the past decade (p. 77).
- National Science Foundation (NSF) and NIH research supplement grants complementing federal project grants should be continued (p. 77).
- The recommended specialized manpower and research programs would include funds for associated institutional costs in addition to traineeship support. These grants, awarded through the federal mission-oriented agencies, would be similar to the NIH training grant programs, with the institutional support component used for such expenses as special equipment, renovation of facilities, and salaries for faculty and support staff (pp. 77–78).
- Funding of the general institutional support provisions of the Education Amendments of 1972 (Title X, Sec. 1001) should be based on a separate assessment of the needs of all sectors of postsecondary education (p. 78).

9

The complexities inherent in university–federal government relationships create a need for improved forms of analytical and policy coordination at the federal level:

- We strongly emphasize the need for improved information and analysis as a critically important first step in the long run process of developing sound, flexible, and responsive policies to guide university–federal government relationships. The American Council on Education should convene conferences to discuss and develop a framework for analysis and to allocate responsibilities among specific private and public groups for securing consistent and timely data. The operation of an improved information and analytical structure would require additional funds, and Congress would, in our judgment, be wise to supply the necessary resources for an improved system (pp. 81–83).

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[4] Recommended funding levels for these programs are contained in the final section of this chapter.

- We urge the Science Adviser to call together the heads of the major federal agencies involved in support of graduate education to discuss methods for anticipating and minimizing the harmful effects upon universities, graduate education, and research caused by sudden changes in federal policy and in levels of funding (pp. 83–84).
- We support the current efforts in Congress to introduce a greater degree of systemization into the appropriations process and to redistribute committee assignments in both House and Senate to bring educational matters together more coherently in the House Committee on Education and Labor and in the Senate Committee on Labor and Public Welfare (p. 84).
- We recommend the creation of a Joint Education Committee, similar to the Joint Economic Committee, which would have a role in education and dissemination, without considering substantive legislation (p. 84).

10

State and federal officials have expressed a desire for procedures to develop standard and comparable cost figures for programs of higher education. A number of unresolved and very complex analytical problems confront this effort at the level of graduate education and research, and existing techniques for generating such cost figures are not adequate. This topic is considered in detail in a supplement to this report by Frederick E. Balderston of the University of California at Berkeley (pp. 87–109).

A POSITIVE PROGRAM

The main elements of our positive program for federal policy toward graduate education are summarized below, together with an estimate of costs. This program has been developed in light of the currently existing federal programs and levels of support for graduate education and research. We believe that our program and recommendations will strengthen the national interest in graduate education and research by improving those federal programs which are presently inadequate, by pointing out some of the existing programs which have proven to be particularly effective and productive, and by promoting the federal responsibility in other areas which are in the national interest.

It must be stressed that these recommendations are not based on a "scientific formula" which produces a uniquely desirable level of support; rather, they are based on levels of support that are reasonably related to the goals and principles spelled out in this report.

Graduate Student Support

1. *Merit fellowships,* to be awarded in national competition on the basis of academic excellence, providing fully portable, three year support and available for study in all academic disciplines. Each fellowship would be accompanied by a cost-of-education allowance, accepted in lieu of tuition and applied toward the institution's cost of providing the graduate training.

We propose 2,000 new awards per year. This means that the number of awards would be equal to about ¼ of 1 percent of the seniors graduating from college each year. Since the National Science Foundation currently awards 500 such fellowships per year in the physical, biological, and social sciences, our recommendation calls for an additional 1,500 awards annually. A counterpart program covering the humanities should be established in the National Endowment for the Humanities, with the total number of awards apportioned between the two agencies in relation to the size and number of eligible disciplines under their purview. Assuming an average stipend of $3,500 per student and a cost-of-education allowance of $4,500,[5] when fully funded, the program would support 6,000 students at an annual cost of $48 million (Table 1).

TABLE 1 Merit Fellowships

Terms per Student		Total Program (New and Continuing Awards)	
Value/Year	Duration, yrs	No. Students/Year	Total Annual Costs
$3,500 stipend $4,500 allowance to institution [a]	3	6,000	$48 million

[a] Cost-of-education allowance in lieu of tuition to be applied toward the institution's costs of providing graduate training.

2. *Specialized manpower and research programs,* providing 5-year grants to universities, and enabling them to develop high priority programs for research and graduate training directed toward solution of urgent national problems. The grants would include graduate student (or postdoctoral) support in the form of traineeships, and funds provided to the institutions for associated program costs such as faculty salaries, equipment, and sup-

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[5] For discussion of this figure, see p. 13.

port personnel. The grants would be awarded to universities on the basis of national competition.

Approximately 70 new grants per year should be awarded over a 3-year period, reaching a steady-state level of roughly 200 projects. Based on prior experience with this form of support, $300,000/year per project would be a reasonable estimate of average project costs. The total annual investment would therefore approximate $20 million the first year, $40 million the second, and $60 million/year when the full program level is reached (Table 2).

TABLE 2 Specialized Manpower and Research Programs

Award to Institution		Total Program (New and Continuing Awards)		
Value/Year [a]	Duration, yrs	Institutional Awards	No. Students/Year	Total Annual Costs
$300,000	5	200	5,000 [b]	$60 million

[a] Approximately 50 percent of the funds would be used for support of predoctoral students (or postdoctoral researchers), including tuition, and 50 percent would be applied toward the institution's cost of providing the program.

[b] Institutions would be permitted to support postdoctoral researchers as well as graduate students according to their program needs.

Approximately half the funds would be used to support both graduate students and postdoctoral researchers. Up to 5,000 predoctoral students could be supported on these programs at full funding levels.

3. *A minority group program*, designed to promote successful participation by historically disadvantaged minority groups in graduate education. Provisions will be specified in a forthcoming report of NBGE.[6]

Comparative Note on Student Support

In 1968 over 51,000 graduate students were supported on federal fellowships and traineeships; under the program recommended above, up to 11,000 students per year would be supported, a level roughly 80 percent below the 1968 high. If the NIH/NIMH training grant programs are added in, more than 60,000 students received financial support from federal fellowships, traineeships, and training grants in 1968. This compares with approximately 20,000 students who would be supported under our recommended program plus the recent appropriation for the NIH/NIMH programs.[7]

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[6] Title IX, Part D of the Education Amendments of 1972 authorizes graduate fellowships for persons of ability from disadvantaged backgrounds, with a maximum of 500 fellowships and $1,000,000/year allowed. Our recommendation regarding this legislation will be included in the forthcoming report.

Research Support

We propose that federal support for basic research should grow, *at a minimum*, at the same rate as the growth of GNP. Table 3 shows the difference between actual expenditures and recommended expenditures that would have occurred had this recommendation been in effect since 1968.

TABLE 3 Federal Expenditures for Basic Research

	Actual Expenditures		Expenditures under NBGE Recommendation		
Year	Amount, $ million	% of GNP	Amount, $ million[a]	% of GNP	Difference, $ million
1968	2,354	0.27	2,354	0.27	
1969	2,398	0.26	2,542	0.27	+144
1970	2,474	0.25	2,730	0.28	+256
1971	2,416	0.23	2,921	0.28	+505
1972 (est.)	2,525	0.21	3,149	0.27	+624

[a] For method of calculation, see p. 68.

This recommendation should not be applied retroactively; the above table is for illustration purposes only. We do propose, however, that our recommendation be applied from this time forward.

Institutional Support

1. *Cost-of-education allowances* accompanying each federally supported fellowship should be increased to $4,500/year to reflect in part the rapid cost increases that have occurred in the past decade.[8] The allowances should be reviewed periodically and increased when necessary to maintain their value in real terms. These allowances would be applicable to the 6,000 merit fellowships.

2. NSF *and* NIH *research supplement grants* should be maintained, with

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[7] On the basis of past experience, we estimate that approximately 9,000 predoctoral students would be supported by the level of funding in the FY 1974 appropriation. (See footnote 3 in this chapter for qualification.)

[8] To offset inflation since 1963 when the figure of $2,500 was established, the allowances would have to be raised to $3,750. At current rates of inflation, the difference between $3,750 and $4,500 will be reached in less than three years.

funding levels set as a modest percentage of federal research project grants. We endorse the FY 1974 Congressional appropriation of approximately $50 million[9] for the NIH General Research Support Grant Program and recommend that this funding level grow modestly as federal support for research increases. The current level of support for the NSF Institutional Grants for Science ($6.9 million) should be increased to roughly $20 million for FY 1975 to restore the proportion of institutional-to-project support that prevailed in the late 1960's before the phase out began.

3. *Specialized manpower and research programs* contain an institutional support component for costs associated with the programs. Roughly 50 percent of the recommended annual funding level of $60 million (Table 2) would be applied toward institutional expenses.

This chapter is, necessarily, only a brief outline of our principal conclusions and positive program. Subsequent chapters contain additional conclusions and recommendations which we believe are important to an effective federal role in graduate education and research. A number of other issues are also identified as being of national concern, although a direct federal role is not proposed.

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[9] See footnote 3, p. 6, for qualification.

2 A Brief History of Federal Support for Graduate Education and Research

Federal support for graduate education and research began, developed, and has been sustained on the assumption that certain national goals and objectives can best be served through investment in these activities. Extensive federal support for research and graduate education began during World War II and developed in its aftermath. The war created a need for highly sophisticated scientific manpower and knowledge. University scientists were quick to respond and produced spectacular results. After the war, the *ad hoc* wartime arrangements were modified and institutionalized to ensure the continuation of scientific research required for defense and for an expanding series of civilian needs.

Because wartime needs centered around the demand for specific research results, government support was initially provided for defense research efforts. Later, it became clear that continued progress on a broader front depended on the steady flow of creative minds into a number of other areas. Thus, federal funds were provided to increase the number of graduate students in fields of high national priority and raise the quality of graduate education in these fields. While emphasis in both research and student support was largely oriented toward the sciences, there has been increased recognition in recent years of the importance of the social sciences and of the arts and humanities.

RESEARCH SUPPORT

The nature of federal involvement in graduate education and research was influenced by the way in which it developed, i.e., under crisis conditions and the need to mobilize the scientific community for war. The Office of Scientific Research and Development (OSRD)—the primary agency for organizing the World War II research effort—was the center of a vast, organized, and successful effort to exploit science for military purposes. The success of the wartime effort suggested that science could be utilized equally effectively for peaceful ends and there gradually emerged a system to organize research for a wide variety of national objectives. Under this system, decisions on research priorities were made in a decentralized fashion by the government agencies which sponsored the research and development (R&D). As most R&D funds were already concentrated in military endeavors, with the Cold War, most federally sponsored research and development in colleges and universities continued to come from defense-related agencies, particularly the United States Department of Defense and the United States Atomic Energy Commission. In the late 1950's, Sputnik stimulated the rapid growth of the National Aeronautics and Space Administration (NASA). In addition to large expenditures on development and applied research, each of these mission-oriented agencies devoted portions of their R&D funds to basic research in their fields, much of which was conducted at universities. In so doing, these agencies were heeding the advice of Vannevar Bush given in 1945: "Basic scientific research is scientific capital."

In the late 1950's, the National Institutes of Health (NIH), building on a solid post-World War II base, began receiving large amounts of federal support for research in the biomedical sciences. Since its establishment in the 1930's NIH has displayed characteristics of both the mission-oriented and basic research-oriented agencies in its mode of operation.

With the founding of the National Science Foundation in 1950, an agency was established whose primary role was the support of basic scientific research. On the whole, NSF has made research funds available without asking that each supported project serve an immediate federal purpose. More recently, NSF has increased its support of social science research. In 1965, the National Foundation for the Arts and Humanities was created, making federal funds available in these areas, although the amounts have remained small by comparison with the sciences.

By establishing and fostering the National Science Foundation and the National Foundation for the Arts and Humanities, the federal government recognized that research in colleges and universities is a national resource, deserving federal support without reference to specific practical objectives. The federal government relies heavily on universities for basic research findings, and the universities depend on federal funds to finance much of this research. During the decade 1963–1972, 52 percent of all federal expenditures for basic research went to universities, while 60 percent of all basic research carried out at universities was supported by the federal government.[1] (See Table 4.)

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[1] National Science Foundation, *National Patterns of R & D Resources, 1953–1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE 4 Federal Support of Basic Research at Universities and Colleges

Fiscal Year	Current dollars		Constant dollars	
	Amount, $ million	Change, %	Amount, $ million	Change, %
1963	610		569	
		+108		+82
1968	1,268		1,037	
		+ 11		− 7
1972	1,409		964	

SOURCE: National Science Foundation, *National Patterns of R&D Resources, 1953-1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

Federal expenditures for basic research in colleges and universities expanded rapidly during the early and middle 1960's, then levelled off (in constant dollars)[2] in the late 1960's and early 1970's (Appendix Table A.1). In constant dollars, this federal support increased 82 percent between 1963 and 1968, but declined 7 percent between 1968 and 1972.[3]

The provision of federal funds for basic research has not led to a reduction in the universities' own support of research, but to a steady increase (Appendix Table A.2). From 1963 to 1968, the universities' own expenditures for basic research in constant dollars rose by 59 percent, and increased an additional 28 percent from 1968 to 1972 at a time when federal expenditures were levelling off (Appendix Table A.3). As a consequence, university funds accounted for 33 percent of university basic research expenditures in 1963, 31 percent in 1968, and 38 percent in 1972 (Appendix Table A.3). As these figures show, the university investment in research has grown more steadily and rapidly than the federal investment, although in recent years this has been possible only by constraining university expenditures in other important areas.

There have been marked changes in patterns of federal support for academic research and development over the years. For example, the proportion of federal funds for academic R&D provided by the United States Department of Defense fell from 26 percent in 1963 to 13 percent in 1972. Conversely, the proportion provided by the United States Department of Health, Education and Welfare (HEW) rose over the same period from 40 to 48 percent and the proportion by NSF from 13 to 18 percent (Appendix Table A.4).

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[2] Higher education is a service industry and hence subject to a higher rate of inflation than the general economy. Thus, the use of the GNP price deflator, upon which we rely, understates the rate of inflation for educational institutions. See National Science Foundation, *A Price Index for Deflation of Academic R&D Expenditures* (Washington, D.C.: U.S. Government Printing Office, 1972).

[3] Federal expenditures for *total* research and development in universities and colleges followed a similar pattern, rising by 81 percent in constant dollars from 1963 to 1968, and declining by 5 percent from 1968 to 1972 (Appendix Table A.1).

Recently there has been a tendency to direct federal funds for academic science more specifically towards the resolution of defined problems of high current significance. This trend is difficult to quantify, but it exists. Examples are the cancer program supported by NIH, the program of Research Applied to National Needs (RANN) supported by NSF, and the university-based research programs of the Department of Housing and Urban Development (HUD). The application of university expertise to help solve urgent national problems is a sound course, provided the shifts in emphasis do not undercut the quality and variety of basic research that are the essential underpinning of successful research applications. This is a real danger because of the tendency to value most highly the immediately practical.

As an overall index, the total federal commitment to research and development (as measured by the percent of GNP devoted to this function) has declined steadily since 1964, from 1.98 percent of GNP to 1.38 percent in 1972 (Appendix Table A.6).

STUDENT SUPPORT

The training of scholarly and scientific talent through federally financed graduate education was not seen as an important national concern until the late 1950's. The education of skilled manpower for university research and teaching and for research work in other areas of the economy became a high national priority. It was argued that the national interest required federal initiatives to alleviate manpower shortages, particularly in the physical sciences, engineering, and the health sciences. As a result, large amounts of federal funds were made available through the following sources:

1. fellowships and traineeships, which combined student support with institutional cost-of-education allowances in lieu of tuition and fees;
2. research assistantships, which provided student and institutional support as part of federally funded research projects; and
3. training grants, which were developed by NIH as program packages and which included support for faculty and equipment as well as for students.

Although NSF had begun a modest graduate fellowship program in 1952, the passage of the National Defense Education Act (NDEA) in 1958 marked the beginning of a large scale federal program of graduate student support. This landmark legislation contained the NDEA Title IV fellowship program, which was significant for its size—over $86 million obligated in 1968—and its breadth—supported many areas of study and was the only major federal fellowship program available to humanities graduate students. This legislation also introduced the National Defense (now Direct) Student Loan (NDSL) program which has provided increasing (though small) amounts for graduate student loans.

Other federal agencies were quick to introduce new graduate student support programs or to expand existing ones. NIH health manpower appropriations for fellowships and training grants increased steadily with enactments such as the Public Health Service Act (as amended in 1960 and 1970), the Health Manpower Act of 1958 (as amended in 1968) and the Graduate Public Health Training Amendments of 1964. NSF expanded its fellowship program and introduced a traineeship program, with grants awarded through the universities. At its height in 1968, NSF obligated approximately $45 million for graduate student support through these programs. NASA was another source of traineeships, with obligations of over $25 million in 1966.

As a consequence of all of these developments, which came about without any consideration of their combined effects, there was a sharp escalation of the scale of fellowship and traineeship support for graduate students. In 1963, 15,600 graduate students were supported on federal fellowships and traineeships, and by 1968 this number had risen to 51,400—more than a tripling over a 5-year period (Appendix Table A.7). Over this period support funds also more than tripled—from $80.7 million in 1963 to $262.1 million in 1968. The proportion of all full-time graduate students supported by federal fellowships and traineeships increased from 6.4 percent in 1960 to 16.0 percent in 1968, the peak year.[4]

The number of federal fellowships and traineeships declined in the early 1970's as rapidly as it grew in the 1960's. After levelling off in 1967 and 1968 at over 50,000 students supported, the number dropped to an estimated 6,600 supported in FY 1974.[5] There have been no new NDEA fellowship awards since 1972, the NSF traineeship program has been phased out and the fellowship program reduced to 500 new awards annually, and NASA's traineeship programs are virtually eliminated. Overall federal support levels for fellowships and traineeships declined from a high of $262 million in 1968 to $114 million in 1972, and have been projected (based on the proposed FY 1974 Budget) to be approximately $33 million in FY 1974.[6]

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[4] Federal Interagency Committee on Education, *Report on Federal Predoctoral Student Support*, Part I (Washington, D.C.: U.S. Government Printing Office, 1970). These figures do not include students supported by NIH/NIMH training grants or on research assistantships. Fellowship and traineeship data referred to here and subsequently apply only to predoctoral students.

[5] Unpublished data collected by the Federal Interagency Committee on Education. FY 1974 estimates are based on the proposed FY 1974 Budget, not final appropriations.

[6] Federal Interagency Committee on Education.

The training grant programs of NIH and NIMH have been a continuing source of substantial predoctoral and postdoctoral support in the biomedical sciences. Training grants differ from other forms of fellowship and traineeship programs in that they provide funds not only for student support but also for other requirements of the research environment, including equipment, salaries of support staff, laboratory supplies, and some professorial salaries. The number of NIH trainees has remained relatively constant since 1966 at about 15,000 with an estimated 40 percent of that number on postdoctoral appointments. Over this period, funds for training grants have generally exceeded $130 million annually (Appendix Table A.7). While the training grant program was slated for elimination in the FY 1974 Budget, the HEW appropriations bill enacted and signed in December 1973 retains the training grant program in size and substance. (See footnote 3, Chapter 1, for qualification.)

Research assistantships have been a major continuing source of federal support to graduate students, especially in the sciences. Because research assistants are funded through research project grants, their numbers and the amount of resources devoted to their support are hard to determine. A recent NSF survey[7] of a large sample of graduate science departments indicates that almost two thirds of all research assistantships in the sciences are federally funded, and that over the period 1969–1972, the number of federally supported research assistants declined in these sampled departments by a moderate 4.8 percent.

The decline of fellowships was accompanied by an increase in federal obligations for student loans and work–study programs for which graduate students are eligible. Approximately 6 percent of the current National Direct Student Loan recipients are graduate students. The number of graduate students receiving support under this program rose from 13,000 in 1963 to 36,900 in 1972 (Appendix Table A.8). The Guaranteed Student Loan Program (GSL) provides government insurance for private loans as well as partial subsidy on interest payments. Begun in 1965, approximately 9 percent of GSL funds have supported graduate student loans, with the amount borrowed by graduate students under this program rising from $7 million in 1966 to $117 million in 1972. The College Work–Study Program (CWSP), also established in 1965, was designed to provide supplemental money through part-time work in the community. Graduate students have received only about 4 percent of the funds under this program, with the amount increasing from $2.2 million in 1965 to $10.9 million in 1972 (Appendix Table A.8).

A major source of federal funds often neglected when considering graduate student support is the G.I. Bill. A new bill covering Viet Nam era

[7] National Science Foundation. *Graduate Student Support and Manpower Resources in Graduate Education*. Science Resources Series (unpublished data from Fall 1972 survey).

veterans and servicemen began in 1967. The importance of this money for eligible graduate students is readily apparent when one notes that educational benefits for graduate students rose to $210 million in 1972 and supported over 170,000 graduate students (Appendix Table A.9).

INSTITUTIONAL SUPPORT

Although basic institutional support has been the responsibility of the states and private sources, federal support of colleges and universities has had a long, though limited, history dating from the original provision for land grant universities in the 1860's. In recent years, the federal government has provided institutional support[8] for a variety of specific objectives deemed in the national interest. These have included construction grants and loans, support for developing institutions, and general support for discipline areas such as sciences and languages. For the purposes of this report, institutional support will be limited to those funds directed explicitly at graduate education. Thus, no attempt will be made to estimate, for example, how much of general facilities grants goes toward graduate education. Given this definition, there are four basic kinds of federal institutional support for graduate education and research:

1. cost-of-education allowances associated with fellowships and traineeships and tuition payments associated with training grants;
2. NIH and NSF research supplement grants;
3. general program support, principally from NSF; and
4. grants for R&D plant and graduate facility construction grants.

Cost-of-education allowances, typically $2,500 per year,[9] have accompanied all of the major federal fellowship and traineeship grants and have generally been accepted by the universities in lieu of tuition. These allowances are a partial compensation to the institution for the costs of providing graduate education.[10] Since the allowances are attached to each award recipient, the amount of benefits a university receives will vary with the

[8] We define "institutional support" as unrestricted or general purpose funds, with expenditure not tied to a specific project, faculty member, or student.

[9] The cost-of-education allowance accompanying NSF Predoctoral Fellowships increased to $3,000 in 1972.

[10] Since the university accepts the allowance in lieu of tuition, an amount equal to the university's tuition should properly be viewed as student support, with the excess, if any, treated as the component of institutional support. Since tuition levels vary among universities, the existing data on student support have not been collected or apportioned in this technically correct way; instead, the reported data treat the entire cost-of-education allowance as student support. Of necessity, our appendix tables follow this procedure.

number of fellows and trainees enrolled. The rapid decline in these awards in recent years has sharply reduced the dollar volume of these allowances (Appendix Table A.10). Preliminary estimates show that cost-of-education allowances for fellowships and traineeships rose from $36.3 million in 1963 to a peak of $117.9 million in 1968, falling to $51.2 million by 1972.

Both NIH and NSF have provided unrestricted formula grants to institutions to help them offset the rigidities of the existing project grant system of research support. These grants give the university greater flexibility in the research process, covering additional costs and providing for unforeseen needs and opportunities. The two primary programs in this area are the NSF Institutional Grants for Science Program (begun in 1961), which provides grants based on the institution's previous year's federal research support, and the NIH General Research Support Grants (established in 1960), which provide funds based on the amount of NIH and NIMH grants received (Appendix Table A.11). Funds for these programs have declined considerably in the last five years.[11] In addition to these two programs, NIH has provided formula grants to schools of public health in growing amounts in recent years.

The third category of support includes the NSF's University and Departmental Science Development Programs. These programs were intended to raise the quality of graduate science education and research in existing universities, thereby increasing the numbers of centers of scientific excellence and broadening the geographic dispersion of such centers. The NSF Science Development Programs were terminated in 1972 after expenditures of approximately $232 million since 1965 (Appendix Table A.11).

As noted earlier in this chapter, the NIH training grant programs have provided support for such items as equipment, professional salaries, and laboratory supplies in addition to student support. An estimate of the institutional component of the training grants (which we have called training grant supplements) is contained in Appendix Table A.10. These funds do not represent institutional support as we have defined it, for they are restricted to particular training programs or departments. On the other hand, they should not be treated as student support as they are often reported. Consequently, we have included them in summary figures as institutional support (Appendix Table A.13), but their hybrid nature should be recognized.

Special grants for R&D plant and equipment, the fourth support category, have fallen off sharply in recent years, from a high of $126 million in 1965 to a low of $30 million in 1971 with a small increase in 1972 (Appendix

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[11] In 1968, the two programs were funded at a level of $60 million; the FY 1974 Budget proposed funding of the two programs at $15 million, but in December 1973, Congress increased the NIH program to roughly $50 million. NSF dispersed $6.9 million under the Institutional Grants for Science in January 1974.

Table A.12). Most of these funds are provided by NIH and NSF, where the major cutbacks occurred. In addition, Title VII-B of the Higher Education Act of 1965 was a source of funds administered by the United States Office of Education for graduate facilities and equipment (not specifically scientific). Appropriations under this title were made through 1968; although authorization for additional funding continues to exist, no new appropriations have since been made.

Finally, the Education Amendments of 1972 authorize two programs for general support of graduate programs. Both programs—one in Title IX providing for competitive grants, and one in Title X providing formula grants to all schools—remain unfunded.

SUMMARY

After the rise in federal support for research and graduate education dating approximately from World War II through 1968, a substantial change occurred in the composition and amount of federal support for these activities. Federal support for fellowships and traineeships declined by 57 percent between 1968 and 1972, with further substantial reductions scheduled for 1973 and 1974. These reductions were offset by the rapid, though temporary, increase in G.I. Bill benefits, with the result that federal support for graduate students fell by approximately 10 percent in real terms from 1968 to 1972 (Appendix Table A.13). In addition, institutional support declined by 52 percent and research support by 5 percent in real terms over those years (Appendix Table A.13). The causes of these changes are complex. So far as student support and institutional support are concerned, the declines are traceable to changes in the job market, the philosophy and priorities of the administration and Congress, the state of the federal budget, and changes in general public attitudes toward higher education. The moderate decline in real terms in federal support of academic research reflects a similar set of factors—decreased general confidence in the utility of basic science, a decline of expenditures on space science, and changing federal budget priorities.

There has been a significant policy history as well as a funding history of federal support of research and graduate education. A number of significant principles, which are now being re-examined, evolved over the years. These were never clearly defined as guides to action. Instead, they were forged from practical experience and continuing debate:

1. Federal support for R&D would be provided by a large number of agencies, each with a mission defined by Congress. (This had the advantage of linking research to defined needs that were politically recognized, and of

making the agencies aware of the power of research. It had the disadvantage of creating an unwieldy system.)

2. Heavy reliance would be placed on universities for the conduct of basic research. This was a different pattern from those nations which have tended to concentrate basic research in nonacademic institutes and governmental laboratories. The United States pattern has been advantageous because it has produced both high quality research and high quality scientists. It has also generated problems because the universities have become heavily dependent upon the federal government.

3. Most of the federal funds were provided to attain short-run objectives of the federal agencies. However, basic research was supported by a number of agencies as a means of attaining their long range goals.

4. A continuing expansion of federal funds for academic science and for support of graduate students was accepted for many years as wise science policy.

5. The widespread assumption of the 1950's that continuing extension of federal support for higher education (including research and graduate education) could lead to a loss of university autonomy was replaced by the assumption that expansion of federal support was beneficial and that undue encroachment by government could be avoided.

6. There has been a consistent assumption, modified only slightly in recent years, that the general health of colleges and universities is not a central responsibility of the federal government. (The large volume of federal funds, however, has made many universities dependent on continued federal assistance for their stability and vitality.)

These assumptions are currently being re-examined, as are the levels of federal support for graduate education and research.

3 Pressures and Problems Facing Graduate Education

The role of the federal government in graduate education, scholarship and research cannot be satisfactorily discussed without considering the purposes to be served by graduate education, and the desirable direction of its evolution in the 1970's and 1980's. If graduate education is to contribute most effectively to society now and in the future—the most general and basic goal —we see action to attain the following goals as urgent:

- *Enhancing the effectiveness and efficiency of graduate education, scholarship, and research.*

Strengthening the national structure for graduate education, scholarship, and research by supporting strong programs currently in existence in all regions and ensuring that the most talented students are not denied access to these programs.

Discouraging the proliferation of graduate programs, while ensuring that universities have the necessary resources to develop programs in new fields of study and to meet new social needs. In a period of limited resources for higher education, careful review and elimination of weak graduate programs is one potential source of the resources required for such new programs.

Ensuring that the supply of persons with master's, professional, and doctoral level education is in reasonable balance with the long term demands of a complex, technological society.

Sustaining a flow of new research findings, basic and applied, required for both the cultural and material well being of the nation.

Protecting the freedom and the adaptive capacity of the nation's universities.

- *Ensuring the responsiveness of graduate education to the needs of society.*

Ensuring that graduate education contributes to the national commitment to eliminate discrimination based on race, sex, age and socioeconomic status.

Stimulating changes that will encourage the most effective contribution of graduate education and research to the solution of urgent national problems.

Encouraging responsiveness to the needs of students, including the development of graduate programs that serve part-time and older students, as well as the needs of urban residents.

The task of policy formation is to determine the relative emphasis to be placed on each of these goals in light of the problems and pressures which confront graduate education, the subject of this chapter. In part, this involves issues internal to the university—including reform and innovation at the institutional level, effectiveness of graduate education and research, relationships between undergraduate and graduate education, and conformity and imitation in graduate education. Some of these issues are discussed here briefly but will be treated more fully in subsequent reports. Primary emphasis in the present report is on system-wide concerns where there is a clear federal government interest and involvement—including the issues that surround federal support of graduate students, research, and universities; the coordination of federal policy toward graduate education; and the geographic distribution of graduate education and research.[1]

In looking to the future to see how graduate education and research can perform more effectively, the fact that we build on a strong base should not be ignored. Graduate education has been flexible and responsive in many ways. It was the instrument through which the teachers were trained for the great expansion of secondary and higher education over the past two decades. Graduate education produced the scientists and engineers for the nation's excellent biomedical research programs. The nation's universities have been the site of the broadest and deepest penetration of new frontiers of knowledge since the scientific revolution.

Accordingly, we do not view graduate education as being in a state of ineffectiveness or weakness. On the contrary, it is strong in terms of the capacity of its faculties and the abilities of its students, broad in terms of fields of learning, significantly responsive to social needs, intellectually rich in terms of library and research resources, widely dispersed throughout the nation, and diverse in approach and content. These are assets which make it possible to approach the problems of readjustment to the future with confidence.

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[1] The distinction between institutional and system-wide concerns is discussed in the first report of the National Board on Graduate Education, *Graduate Education: Purposes, Problems, and Potential* (Washington, D.C.: National Board on Graduate Education, 1972) pp. 6–7.

These accomplishments are recorded not as a basis for self satisfaction, nor as a plea for retention of the *status quo*. They are stated to emphasize that the tasks of readjustment, which are real, complicated, difficult, and necessarily slow-moving, can be approached with confidence.

LABOR MARKET PROSPECTS FOR DOCTORATES

The recent softening of the labor market for doctorates in some fields, coupled with projections of steadily diminishing academic demand for new doctorates in the 1980's, is a major challenge facing graduate education. The current labor market problem is fundamental to a number of other issues to be discussed in this section since a primary rationale for the large increases in federal support for graduate students, programs, and research during the late 1950's and much of the 1960's was the shortage of highly educated manpower. The virtual elimination in recent years of federal fellowships and traineeships is, in part, a response to the softened labor market.

Because the current and projected state of the labor market for doctorates is of such central importance to many policy issues surrounding graduate education, the National Board on Graduate Education gave this topic first priority in its investigations and has issued a report containing NBGE conclusions and recommendations.[2] The main points of that report are summarized below:

1. Labor market forecasting techniques are not well-developed. The history of past forecasts for doctorates shows that projections were in error within a relatively short time. This suggests that undue reliance should not be placed on any given forecast and that the labor market should be constantly monitored, field by field.

2. Since graduate education requires several years to complete, policies that influence beginning graduate student decisions will affect the supply of new doctorates 3–6 years in the future. This time lag in supply means that federal policy toward student support should focus on conditions anticipated several years ahead rather than on the immediate state of the labor market.

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[2] National Board on Graduate Education, *Doctorate Manpower Forecasts and Policy* (Washington, D.C.: National Board on Graduate Education, 1973).

TABLE 5 Percent of 1972 Doctorates Reporting First Jobs in Research and Development or Teaching at a College or University

Field	Percent
Physical sciences	41.4
Engineering	28.7
Mathematics	74.2
Life sciences	54.2
Social sciences	63.6
Arts and humanities	84.4
Education	45.1
TOTAL (all fields):	56.3

SOURCE: National Research Council, Doctorate Records File.

Overemphasis on immediate labor market conditions—whether for expansion or contraction—increases, rather than dampens, cyclical fluctuations in the labor market. Current contractionary polices may lead to shortages of doctorates in specific disciplines several years hence.

3. Of the three labor market elements examined—future academic demand, nonacademic demand, and supply of new doctorates—only the projections of diminished academic demand for doctorates in the 1980's inspire much confidence. The size and disciplinary composition of future doctorate supply is uncertain, and the nature of future nonacademic demand is poorly understood.

4. There is evidence of shifts in the pattern of graduate student enrollments away from disciplines that primarily serve the academic labor market, and into professionally oriented programs that serve major nonacademic market demands. In addition, the growth in graduate enrollments has slowed considerably from the rapid increases of the 1960's,[3] which means that future doctorate supply will be considerably below levels projected one or two years ago.

5. The existence of substantial nonacademic demand for doctorates is often overlooked in much of the labor market discussion; moreover, the proportion of doctorates that have accepted research and teaching positions in colleges and universities has always varied widely among the disciplines (Table 5).

[3] First-year graduate enrollments increased at an average annual rate of 11 percent during the period from 1960 to 1968, but by 1971, first-year graduate enrollments increased by only 0.1 percent over the preceding year. Enrollment surveys conducted by the Council of Graduate Schools and the Graduate Record Examinations Board show increases in first-year graduate enrollments of 3–5 percent in 1972 and 1973.

6. There is a great need to improve the information available on the current and projected state of the labor market for highly educated manpower; however, this should be done, not for the purpose of rationing or controlling access to graduate education, but to improve the functioning of the labor market as an allocative mechanism.

Although the above discussion indicates some of the reasons why we believe a glut of unemployed Ph.D.'s will not develop, graduate education does face major adjustment problems to changing labor market conditions. The projected decline of the academic market and the newly emerging demand for professionally trained individuals who can contribute to the solution of energy, environmental, and urban problems will require the reallocation of resources within universities in order to develop new professional (and interdisciplinary) graduate programs. At the same time, it would be irresponsible to allow deterioration in the quality of graduate programs of acknowledged excellence. Each university is having to resolve these conflicting demands and pressures in an environment made more difficult by increasing financial problems.

FINANCIAL PRESSURES AFFECTING GRADUATE EDUCATION AND RESEARCH

In a landmark book published by the Carnegie Commission in 1971, Earl F. Cheit focused national attention on the "New Depression in Higher Education."[4] Cheit's study of the financial circumstances of 41 institutions demonstrated that many colleges and universities in the United States were experiencing a general erosion of financial position. Expenditures were outpacing income and the resulting gap placed severe financial pressure on the institutions. In a recent follow-up study,[5] Cheit documented remarkable reductions in the rate of expenditure increase in the 41 institutions (in terms of rising expenditure per student per year, the rate dropped from 4.0 percent above the general rate of inflation to 0.5 percent), and he described the existing situation as one of "fragile stability." For the universities with heavy investments in graduate education and research, however, the future outlook remains uncertain:

> As a group, the research universities seem to be in the greatest state of concern about their future. The public institutions are somewhat demoralized about the qualitative leveling to which they fear they will be subject. The private universities,

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[4] Earl F. Cheit, *The New Depression in Higher Education* (New York: McGraw-Hill, 1971).

[5] Earl F. Cheit, *The New Depression in Higher Education—Two Years Later* (New York: McGraw-Hill, 1973).

> even those financially secure, have doubts about their future as research institutions. This is a fear born of restrictive federal policies toward funding graduate education and toward science, especially basic research.[6]

Several aspects of the current financial distress of universities are noted below.

Reductions in Support of Basic Research

Universities perform the bulk of basic research in this country, far outdistancing the next largest performer—industry. In 1972, universities accounted for 59 percent of total basic research expenditures (up from 43 percent in 1960), while industry's share fell from 28 percent in 1960 to 15 percent in 1972.[7] Universities have a comparative advantage over other organizations in producing basic research since the university environment encourages and supports such investigation freely and in its own right. In addition, the university combines research with graduate education, thereby generating economies of joint production, i.e., graduate students make substantial contributions to research as part of their advanced education. Because of the growing importance of externally funded basic research in financing the costs of the research component of graduate education, reductions in basic research expenditures are a particular hardship for this sector of higher education. The following figures highlight the recent cutbacks mentioned in the previous chapter. Figure 1 shows that expenditures for basic research in universities and colleges from *all* sources, having grown rapidly until 1968, have grown only modestly since that year.[8]

The federal government plays a particularly significant role in supporting basic research, with outlays in 1972 accounting for 62 percent of total basic research expenditures. In constant dollar terms, however, federal expenditures for basic research have declined by more than 7 percent over the 1968–1972 period. Figure 2 shows this trend, with the pronounced drop in constant dollar expenditures beginning in 1968.

These data document an important element in the current financial distress of universities; not only have federal basic research expenditures declined in absolute constant dollar terms in recent years, but—by comparison with the extraordinary growth rates in prior years—the turnaround came as

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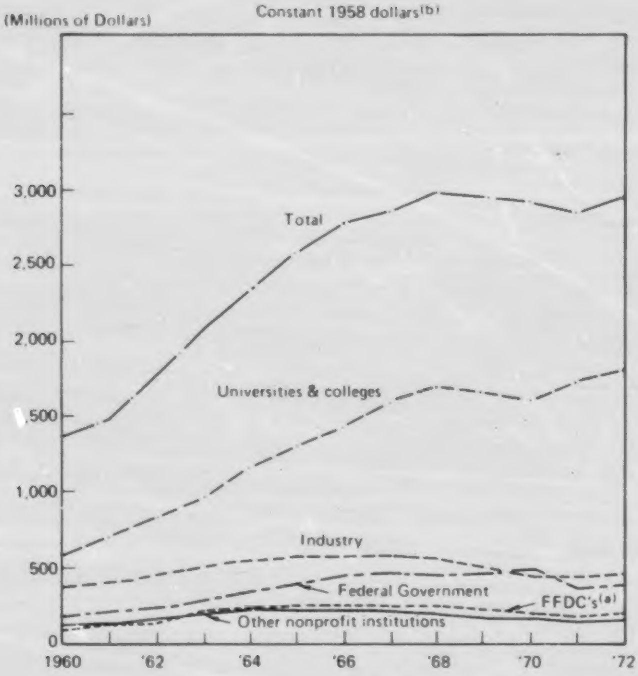
[6] *Ibid.*, pp. 49–50.

[7] National Science Board, *Science Indicators 1972* (Washington, D.C.: U.S. Government Printing Office, 1973), and National Science Foundation, *National Patterns of R & D Resources* (Washington, D.C.: U.S. Government Printing Office, 1973). Unless otherwise noted, all references to data in this section are taken from these informative reports.

[8] National Science Board, *Science Indicators 1972*, *op. cit.*, p. 34. See also Appendix Table A.3.



(a) Federally Funded Research and Development Centers

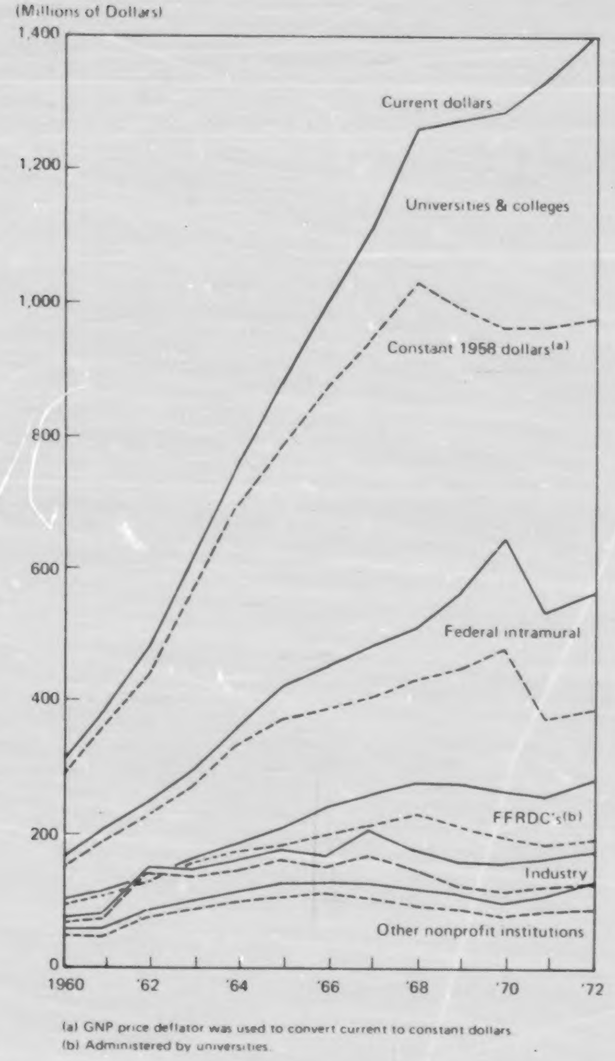
(b) GNP price deflator was used to convert current to constant dollars

FIGURE 1 Basic research expenditures, 1960–1972, by performer. [Adapted from National Science Board, *Science Indicators 1972* (Washington, D.C.: U.S. Government Printing Office, 1973), p. 35.].

an abrupt shock. Rapid changes of this sort make the academic planning process within universities difficult, resulting in inefficiencies that could be avoided by more stable funding patterns.

The Decline in Graduate Student Financial Support

Compounding the difficulties created by cutbacks in federal research support, an equally rapid reduction in the number of graduate students sup-



(a) GNP price deflator was used to convert current to constant dollars.
(b) Administered by universities.

FIGURE 2 Federal expenditures for basic research by performer, 1960–1972. [Adapted from National Science Board, *Science Indicators 1972*, op. cit. p. 36.]

ported by federal fellowships and traineeships began in FY 1968. Table 6 charts the trend in such support for FY 1968 to FY 1974 (projected). The 85 percent reduction in the number of students supported on federal fellowships and traineeships during the period FY 1968–1974 coincided with the end of a number of private fellowship programs such as the Woodrow Wilson Fellowship Program, leaving only a limited number of private foundation fellowships available to potential graduate students. The major remaining federal predoctoral fellowship program, sponsored by the National Science Foundation, is budgeted for only 500 new awards each year.

TABLE 6 Graduate Students Supported on Federal Fellowships and Traineeships, 1968–1974

Fiscal Year	No. Students Supported
1968	51,446
1969	42,551
1970	33,240
1971	28,973
1972	24,808
1973	19,649
1974 (projected)	6,602

SOURCE: Federal Interagency Committee on Education, *Report of Federal Predoctoral Student Support*, Part I (Washington, D.C.: U.S. Government Printing Office, 1970), and unpublished data for recent years. The number projected for 1974 is based upon the FY 1974 Budget, not final appropriations. Data do not include students supported on NIH/NIMH training grants.

These striking reductions in graduate student support have created the following problems:

1. Pressure is placed upon the university's limited funds as a partial offset to declining federal and private sources of support.
2. Graduate students now compete with undergraduate students for NDSL and GSL loan funds, for work–study funds, and for jobs near campus, thereby reducing the support available for undergraduates.
3. Access to graduate education for the poor and for many minority group members will be increasingly difficult as the total supply of support funds declines.
4. The loss of cost-of-education supplements that accompanied most fellowships has deprived the university of an important source of funds that helped to cover the cost of graduate programs.

In dollar terms, the recent increase in G.I. Bill benefits has offset much of this decline in fellowships and traineeships, although the G.I. Bill is not a true substitute for these funds since it is granted on the basis of different criteria. In 1973, over 37 percent of the total estimated federal outlay in support of graduate students was provided by the Veteran's Administration,[9] but this support is expected to fall from the 1973 peak of $245 million in subsequent years as the number of eligible veterans declines. This will remove a major source of student support that has helped to fill the gap created by the decline of fellowships and traineeships.

Two further sources of graduate student support—teaching and research assistantships—have remained essentially level over the four year period 1969–1972, while graduate student borrowing under the various guaranteed loan programs has increased markedly in recent years (details in Chapter 4).

This shifting pattern of graduate student support has not produced a substantial decline in graduate school enrollments, but the full effect of recent policy changes has not yet been felt. The decline in fellowships and traineeships, combined with reductions in the numbers of veterans eligible for G.I. Bill benefits, will mean that the burden of providing graduate student support will fall increasingly on the universities and on the students. (Had the NIH training grant programs been eliminated—as proposed in the FY 1974 Budget but rejected by Congress—the student support situation would have been even more severe.) Universities will be severely limited in their ability to increase graduate student support from institutional funds, and thus students will bear a growing share of the burden. We do not know whether large numbers of students will be willing (or able) to borrow substantial sums for graduate school attendance, although there is some doubt that existing loan programs can expand sufficiently under current terms and conditions. We do believe that access to graduate education will be severely limited for certain groups by this major shift of policy; students who borrowed heavily to support undergraduate education, students from low income and disadvantaged families, students from ethnic minority groups, and many women students will be unable or reluctant to incur major debt obligations to attend graduate school.

Problems of Institutional Support and Vitality

As noted in Chapter 2, the federal government has generally not provided direct, untied, and unencumbered funds for institutional support; instead, such funds have accompanied fellowship and traineeship grants as cost-of-education supplements, have been provided by a few agencies (NSF and NIH, primarily) in proportion to the amount of federal research expenditures within universities, or have come as grants for the purchase of R&D plant and equipment. In addition, the NIH training grants provide funds for equipment and faculty salaries, as well as funds for student support, in the high cost areas of biomedical graduate education and research.

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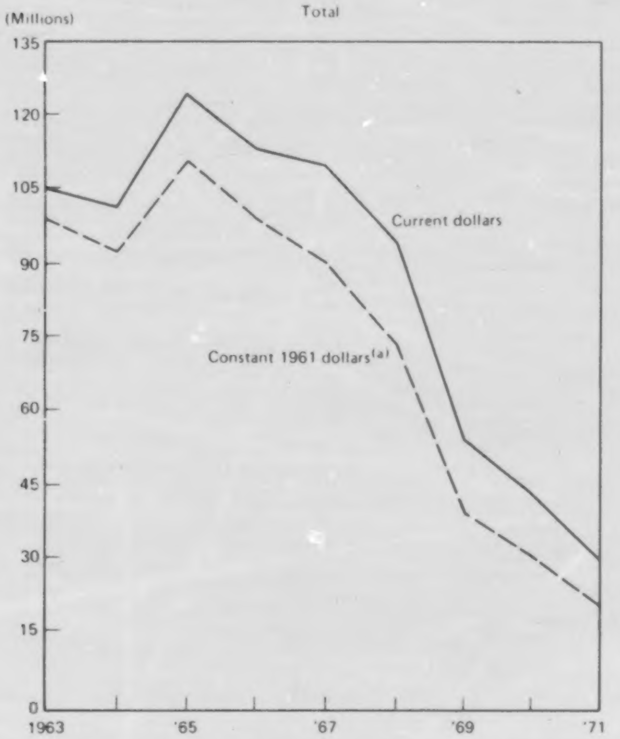
[9] U.S., Executive Office of the President, *The Budget of the U.S. Government Fiscal Year 1974* (Washington, D.C.: U.S. Government Printing Office, 1973), p. 114.

Figure 3 charts the decline of federal obligations for academic R&D plant, a drop of more than 75 percent between 1965 and 1971. In addition, the virtual elimination of fellowships and traineeships has meant the loss of cost-of-education supplements; the funds provided by NSF and NIH in proportion to the amount of federal research grants had declined from $60.1 million in 1968 to $28 million by FY 1973;[10] and the NSF Science Development Program has ended. The loss of these several sources of funds in the last 5



(a) Based on academic R&D price deflator

FIGURE 3 Federal obligations for academic R&D plant, FY 1963–1971. [National Science Board, *Science Indicators 1972*, *op. cit.* p. 73].

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[10] The FY 1974 Budget proposed funding of $15 million for these two programs; in December, 1973, Congress increased the NIH program to roughly $50 million. (See footnote 3, Chapter 1, for qualification.)

years has cost the nation's universities much of the valuable flexibility that such relatively unrestricted funds provide and has contributed significantly to the financial distress of the universities.

ACCESS TO GRADUATE EDUCATION

It has become fundamental to the purposes of postsecondary education that every individual should have the opportunity to develop his or her potential and therefore should not be denied access to postsecondary education because of ethnic, socioeconomic, sex, or age discrimination. This does not mean, however, that every person should be *guaranteed* access at the graduate level (often argued at the undergraduate level) but rather that certain invidious barriers should not prevent individuals or groups of individuals from attaining advanced degrees if they possess the desire and capabilities.

Three instances where special attention is required to ensure equality of opportunity to graduate education are in the cases of ethnic minority groups, women, and older persons. Each of these groups has special needs regarding access to graduate education, although there are common difficulties as well.

Ethnic Minority Groups

Although more than 19 years have passed since the *Brown v. Board of Education* ruling of the United States Supreme Court, blacks and other minority groups remain seriously underrepresented in terms of advanced degrees. It has been estimated, for example, that blacks receive less than 1 percent of doctorates awarded, and a recent survey of over 100 institutions showed that individuals from minority groups—including blacks, native Americans, Chicanos, Oriental Americans and others—represented only 5 percent of total graduate enrollment in those schools.[11] The reasons for lower participation rates may vary to some extent among the various minority groups: For example, for the American Indian, long-standing geographic isolation has been a primary factor. Socioeconomic deprivation, limited aspiration levels, cultural biases in admissions criteria, remaining vestiges of *de facto* discrimination in educational opportunity, and a broad range of historical inequities all interact to lower the participation rate of minority groups in graduate education.

While undergraduate minority group enrollments have increased sharply in recent years, the number of baccalaureates is still inadequate, particularly since this represents the pool of potential candidates for graduate education. In addition, many minority group individuals have not received adequate preparation for graduate education in their undergraduate programs.

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[11] Herman R. Branson, "Black Students and the Elusive Doctorate," unpublished paper prepared for the National Board on Graduate Education, 1973; and I. Bruce Hamilton, *Graduate School Programs for Minority/Disadvantaged Students* (Princeton: Educational Testing Service, 1973).

Financial barriers are also particularly high for many minority group students. For example, while the median family income for the United States in 1971 was $10,285, the median family income for Chicanos was $7,486; Puerto Ricans, $6,185; blacks, $6,567; and for American Indians on reservations, annual average family income was only $1,500.[12] Financial deprivation thus makes it difficult, if not impossible, for many minority group students to attend graduate school without substantial subsidy.

Many graduate schools have made substantial efforts to improve access to graduate education for minority groups, but this is a difficult and complex undertaking. Providing financial assistance to potential graduate students is necessary but by no means sufficient. There are real problems in locating and recruiting minority group students, and in providing enrolled students with appropriate counseling services. Minority students in some institutions have experienced high attrition rates. Successful programs to address these problems impose substantial financial costs on the institutions.[13]

The historically black colleges continue to provide a supportive environment for many blacks at the graduate level, but these schools are beset with financial and educational difficulties. Many emphasize teacher training programs and cannot, at present, provide the range of graduate programs that are effective preparation for many leadership roles in society today, such as public policy, business administration, and economics.

A further issue is the distribution of minority group enrollments among the disciplines. Blacks (data are not available for the enrollment patterns of other minority groups) have entered graduate programs in education to a disproportionate extent, while very few have enrolled in such fields as the physical sciences and engineering.[14] This is clearly inappropriate in light of society's expected employment needs in the future.

The issues involved in promoting successful access to and completion of graduate study by minority group individuals are of such complexity that a thorough analysis was not possible within the constraints of the present report. Because of the importance of this topic, NBGE will issue a separate report on this subject, which will include specific policy recommendations directed to the federal government.

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[12] Department of Health, Education and Welfare, *Report of Task Force on Higher Education for Disadvantaged Minorities*, unpublished draft, December 1972, and Department of Commerce, *Statistical Abstract of the United States, 1972* (Washington, D.C.: U.S. Government Printing Office, 1972), p. 323.

[13] Discussion of several of these issues is contained in Hamilton, *op. cit.*

[14] Branson, *op. cit.*

Women

Women remain underrepresented at all levels of higher education, especially in graduate education. In 1970, women received 43 percent of bachelor's degrees awarded, but only 13 percent of doctorates.[15] While there is recent evidence that a greater percentage of women than men aspire to a master's or doctorate degree, a substantially smaller percentage of women than men are able to continue immediately to graduate school after receiving baccalaureate degees.[16] While instances of explicit institutional discrimination against women in admissions or in financial support for graduate education may be difficult to document, clearly women are not yet participating fully in graduate education. This is particularly discouraging in view of their more rapid persistence to a bachelor's degree and superior undergraduate records.[17] Moreover, women pursuing advanced study are heavily enrolled in such fields as the humanities and education but are almost nonexistent in others such as engineering and business.

Affirmative action employment policies are a major force pushing graduate schools to take a strong interest in women's successful participation in advanced programs. But general concern over the softening of the labor market, together with reductions in financial support for graduate students and a slowing of the growth of graduate programs, act to restrict the opportunities for all aspiring graduate students at a time when women are exerting greater demands for entry into graduate education. Typically, women attend graduate school on a part-time basis more often than men. This may reflect their choice of field to some extent, but if part-time as contrasted to full-time attendance is their only option, women may be precluded from participating in some programs, such as a Ph.D. program in the physical sciences. Moreover, many women with family responsibilities who wish to return to graduate education on a part-time basis are ineligible for financial aid since many aid programs are not available to part-time students.

Perhaps the most serious barrier at this time to full participation in graduate education by women is the diffuse but very real factor of cultural and personal biases toward women in this society. Women may be discouraged from applying to graduate school or may not be "taken seriously" in graduate programs by some faculty or by other graduate students. A 1971 survey reported that fully twice as many men as women expressed the view that a married woman's "activities are best confined to home and family."[18] This

[15] Department of Health, Education and Welfare, *Earned Degrees Conferred: 1969–70, Institutional Data* (Washington, D.C.: U.S. Government Printing Office, 1970).

[16] Alan E. Bayer, Jeannie T. Royer and Richard M. Webb, *Four Years After College Entry* (Washington, D.C.: American Council on Education, 1973).

[17] Leonard L. Baird, *The Graduates* (Princeton: Educational Testing Service, 1973).

[18] Ann S. Bisconti and Helen S. Astin, *Undergraduate and Graduate Study in Scientific Fields* (Washington, D.C.: American Council on Education, 1973).

is consistent with evidence that women who interrupt their graduate studies cite home/child-care responsibilities as the reason to a much greater extent than do men. Role conflicts between wife–mother and career-professional remain difficult to resolve, but the presence of a supportive university environment sensitive to the needs of women (i.e., counseling services to advise women who want to return for advanced education and child care centers on campus) is important in assisting more women to enter and complete graduate study.

We view the appropriate federal role in ensuring full participation of women in graduate education to be one of encouraging sound affirmative action programs in institutions of higher education, in compliance with Executive Order 11246, as amended. In addition, we endorse vigorous support of nondiscrimination in the range of graduate programs, activities, and admissions standards as set forth in Title IX of the Education Amendments of 1972.[19]

Older Students

Rising educational and certification requirements for job advancement, rapidly changing technology, and new fields of knowledge, have caused many adults to want to enroll in graduate programs, often on a part-time basis. It has been suggested that some graduate schools have discriminated against older students in favor of recent baccalaureates, on the assumption that older students might experience higher attrition rates because of family obligations that could conflict with their study, or because of difficulties in adapting to the rigorous learning environment of the graduate school. There is also the very real problem that many universities offer only full-time programs requiring daytime rather than evening attendance.

Financial barriers for older students with family obligations are a further problem, although it is often difficult to assess the financial need of older persons who have accumulated financial assets and commitments. Because many student assistance programs have been restricted to full-time students pursuing doctoral studies, individuals who want to renew or upgrade their professional skills in mid-career by enrolling in master's degree programs, but who need financial aid for this purpose, may be effectively denied that opportunity.

Improved access to graduate education for older students requires, as a first step, action by universities and by the states to ensure that graduate programs in all major cities are accessible to part-time and evening students. More research is needed into the adequacy of existing federal programs in assisting older students, and to determine whether a need exists for new programs specifically designed for this group. For this reason, the creation of new *federal* programs targeted specifically at older students in order to increase their enrollment in graduate education is not among the recommendations in this report. This topic should be investigated by the Fund for the Improvement of Postsecondary Education or by the National Institute of Education, and—if new programs are warranted—Title IX, Part A of the Education Amendments of 1972 should be explored as a possible source of federal support.

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[19] Executive Office of the President, *Nondiscrimination Under Federal Contracts*, Executive Order 11246, as amended; U.S. Congress, Senate, *Education Amendments of 1972*, P.L. 92–318, 92nd Cong., 2d sess., 1972.

PLANNING, MANAGEMENT AND COST ANALYSIS

To an increasing degree and with logic, expenditures for graduate education are viewed in the context of expenditures for other types of postsecondary education. When funds are scarce, choices are forced. Questions of this sort are asked: Should expensive graduate programs be sustained or expanded when the funds devoted to them could provide financial aid enabling additional disadvantaged students to attend college? These questions have a point. If graduate education is to continue to receive a share of resources—private and state as well as federal—that will ensure its optimal contribution to the national welfare, an active concern with costs is essential.

Graduate education shares with all sectors of postsecondary education a responsibility to review costs and to increase the effectiveness with which expensive resources are used. Deans, department heads and faculty members should participate positively in university-wide efforts to ensure that expenditures are reasonable and warranted. This is particularly true for those areas of graduate education that are exceptionally expensive, such as those with few students per senior faculty member, those requiring specialized laboratory resources or expensive research equipment and operations, field work, requirements for computation and other means of analysis.

As part of its general obligation to assess its resources critically to ensure they are allocated wisely, each university should review graduate programs in the light of their contribution to the general goals of the university. Continuing consideration should also be given to sharing expensive resources and facilities among groups of universities. Consortia for graduate study are a means of securing more effective use of expensive resources, and of securing increased access to these by students and faculty. User groups clustered around very expensive facilities are another means of increasing the efficiency with which resources are used.

The problems involved in assessing and improving the effectiveness of graduate education and research are formidable. Cost analysis of graduate programs is extraordinarily complex because of the interrelationships within the university of graduate education with undergraduate education and research. In economics, this situation is described as a "joint product" problem. The "production process" of graduate education, and hence the cost, cannot meaningfully be separated from the "production process" of jointly produced undergraduate education and research. Research and graduate education are inextricably bound together, and two "products" emerge from the process—a highly educated person *and* new research findings (a valued output in its own right). Further complicating the analysis, graduate students who serve as undergraduate teaching assistants become part of the "production process" of undergraduate education, thereby reducing its costs, just as the service of graduate students as research assistants reduces the costs of producing research. For these reasons, the true economic costs of graduate education will necessarily vary over time in relation to the size of undergraduate enrollments and the volume of research activity, and will vary among institutions for similar reasons.

Furthermore, cost figures, whether adequately or inadequately derived, are insufficient in themselves for many of the economic decisions that must be made. Ideally, *costs* must be compared with *benefits* of the activities being considered, and our ability to define and measure benefits is far from perfect.

The proper course of action in this circumstance is to participate fully in efforts to solve these difficult problems. Our principal concern over the growing desire for cost figures on the part of state and federal legislatures is that current techniques for generating such numbers are not capable of accurately reflecting the complex relationships among graduate education, undergraduate education and research. Application of improper or premature techniques would produce nonsense numbers which, if acted upon by decision-makers, could do great damage to the country's graduate education and research capabilities. The growing desire for quick (and simple) solutions to this complex analytical task must be listed as a separate, and major, problem currently confronting graduate education. Because of the importance of this relatively technical topic, the subject is discussed in a supplement to this report, "Difficulties in Cost Analysis of Graduate Education," by Frederick E. Balderston.

ADJUSTMENT PROBLEMS TO THE STEADY STATE OF THE 1970'S

A broader set of concerns that transcends the individual universities involves the system-wide adjustments required of the graduate schools in response to the new steady state of slow (or no) growth. The rapid growth of the system during the 1960's presents a remarkable contrast:

The number of universities offering graduate degree programs (including the master's degree) increased from 605 in 1960 to 808 by 1970.

In 1960, 9,829 Ph.D. degrees and 74,455 master's degrees were awarded; by 1970, these figures had nearly tripled to 29,866 and 208,291 respectively.

First year graduate enrollments increased at an average annual rate of 11 percent between 1960 and 1968.

No social system responds effectively to a sudden halt in such phenomenal growth rates, and the problems are particularly difficult for universities, with highly decentralized decision-making procedures, a reliance on collegial rather than hierarchical forms of organization, and heavy fixed costs. Several of the most difficult adjustment problems are noted below.

Geographic Distribution versus Concentration of Excellence

During the 1960's, it became explicit national policy to encourage the geographic dispersion of funds for graduate education, scholarship, and research. President Johnson's Executive Order of September 13, 1965[20] asserted that every region of the country should be served by excellent graduate schools. As long as rapid growth continued, it was possible to pursue this goal while also strengthening the established universities of acknowledged excellence; however, the constrained resources of the 1970's have placed these two objectives increasingly in conflict. There are those who argue that regional balance in the distribution of graduate facilities should not have high priority, particularly in this decade. It is our position, however, that developing regional points of strength is an important and continuing national responsibility. Two different bases for distribution—population and geography—exist, and need to be discussed separately.

The continued growth and concentration of population in major cities create a demand for graduate programs in urban universities to meet the needs of part-time and older students, largely related to professional career development. Many of the concerns regarding access to graduate education discussed above will best be solved by ensuring that every major urban center is served by universities with a wide spectrum of master's and doctoral programs.

The arguments for geographic distribution are based on the importance of universities to the economic and cultural development of a state or region, and, to a lesser extent, on the concern for improved access to graduate education. (Of course, state universities are vitally important in providing access to undergraduate education; the policy issue is the extent to which geographic considerations alone should influence the flow of resources to *graduate* education.) The economic and cultural significance of universities to a state or region has not been exhaustively studied or measured precisely; consequently, rigorous cost-benefit calculations cannot guide policy decisions. At present, every state has at least one university offering the Ph.D. degree, thereby meeting an obvious minimum requirement. Our judgment is that concern for geographic distribution of resources for graduate education is a valid consideration because of the many contributions that universities make to the collective life of a region. If resources for all higher education continue to tighten, however, such that geographic dispersion comes at the cost of diminished excellence, we would relax the concern for distribution in order to maintain and strengthen excellence wherever it exists.

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[20] U.S. Congress, Senate, Committee on Government Operations, *Equitable Distribution of R&D Funds by Government Agencies, Hearings,* before the Subcommittee on Government Research, Senate, on S. Res. 110, 90th Cong., 1st sess., 1967.

Preserving and Enhancing the Intellectual Vitality of College and University Faculties

The declining academic demand for new Ph.D.'s that will mark the period through the 1980's poses a serious threat to the health and vitality of the academic disciplines, since the continued infusion of new talent through expansion will be sharply diminished. Many colleges and universities face a 10–15-year period with a relatively stable and constantly aging faculty, with little expected turnover and fewer retirements. The difficulties of ensuring a flow of new Ph.D.'s into university positions during this period of slow growth will be compounded by pressures for affirmative action in the hiring of women and minority group members.

The Impact of Federal Actions on the Adjustment Process

We are concerned that recent federal policy, which exercises great leverage over the adjustment process, does not seem to be guided by a clear understanding of the effects of federal action on the evolution of graduate education, scholarship and research. There is preliminary evidence indicating that recent federal policy may produce the following undesirable outcomes (as judged by the goals outlined at the beginning of this chapter):

Increased reliance on a students' own resources to finance graduate education works against the goal of eliminating barriers to graduate education for ethnic minority groups, women, older students, and the socio-economically disadvantaged.

A financial squeeze continuing for several years and caused in part by the reduction of institutional support funds accompanying federal programs will make innovation more, rather than less difficult, as financial flexibility for many universities has been virtually eliminated.

Reduced support for basic research diminishes the capability for subsequent applications of new knowledge which are essential to the nation's economic and cultural well-being.

Reductions in federal fellowship and research support may have a particularly detrimental impact on programs of established excellence, since these programs have received a large share of fellowship students and research funds in the past.

Overreaction to the current supply–demand imbalance of doctorates in some fields may lead to a contractionary cycle resulting in shortages of highly trained persons in certain scientific and technical fields several years hence.

ABSENCE OF COORDINATED FEDERAL POLICIES TOWARD GRADUATE EDUCATION, SCHOLARSHIP AND RESEARCH

Throughout this section we have spoken of "federal policy with respect to graduate education, scholarship, and research," but we have been guilty of imprecision: There is no single federal policy, but rather a multitude of policies emerging from the many federal agencies. This is both a strength and a weakness from the point of view of graduate education. The strength lies in the plurality of funding sources and in the different purposes of the various agencies; the potential control that the federal government could exercise over universities if a single agency dispensed all federal funds is diffused and diluted by the multitude of different contact points among agencies and universities. The weakness results from the fact that the combined impact of the many agency programs upon the strength and balance of the universities is not the responsibility of any part of the executive or legislative branches of the federal government.

The major problem that this absence of coordinated action and information causes the universities is a continuing financial and programmatic uncertainty that impedes academic planning efforts. For example, many universities were encouraged to enter or expand graduate education during the 1960's by federal assurances that such expansion served the national interest. Changing federal priorities have now left many universities with personnel and program commitments that they must continue to meet, without the federal support that had originally encouraged them to undertake those activities.

Of course, these problems can never be fully eliminated, nor should they be; priorities inevitably shift, and the federal government cannot base its actions on what may inconvenience universities the least. We do believe, however, that it is in the national interest to search for methods that can help to reduce the uncertainty that accompanies federal relationships with universities. Chapter 7 is devoted to further development of this topic.

4 Graduate Student Support

Graduate students meet the costs of tuition, fees, books, and living expenses in a variety of ways. Typically, students or their spouses earn some money while enrolled or during vacation periods; they draw on their own or their family's assets; some receive fellowship grants, and others borrow. To provide a factual backdrop for the discussion which follows, some salient facts from NSF surveys of graduate student support in over 2,700 academic departments will be useful (Table 7).[1] Two trends in this large sample are of major significance. The first is a 40 percent decline in the number of students who secured their major support from federal fellowships and traineeships over the period 1969–1972. The second is a 23 percent increase in the number of students for whom self-support was the major source of financing. Self-support means employment (of the student or the spouse), loans or family assistance. There has thus been a very substantial shift over a 4-year period from support of graduate students by society through fellowships to self-support through gifts, loans, and earnings.

This chapter is concerned with aspects of graduate student aid that are pertinent to federal policies over the next few years. The first section con-

[1] The data in Table 7 are based on a large sample of 2706 academic departments in the physical, biological, and social sciences, and are broadly representative of general trends. The NSF departmental surveys from which the data were taken are the most detailed sources of information on graduate student support available. Since the data are provided by department chairmen, the major inadequacy of the surveys are funds, such as the G.I. Bill, which are dispersed directly to the student and do not enter the university's accounting system.

TABLE 7 Change in Sources of Major Support for Full-Time Graduate Students, 2,706 Academic Departments in the Sciences and Engineering, 1969–1972

Sources of Major Support	No. Students Using Source(s) 1969	No. Students Using Source(s) 1972	Change, 1969-1972 No.	Change, 1969-1972 %
Federal fellowships and traineeships	25,558	15,271	−10,287	−40.0
Other fellowships	11,728	10,492	− 1,236	−10.0
Research assistantships	27,690	26,713	− 977	− 3.3
Teaching assistantships	31,518	33,547	+ 2,029	+ 6.3
Self-support	23,903	29,538	+ 5,635	+23.4
Other	8,935	8,820	− 115	− 1.0
TOTAL	129,332	124,381	− 4,951	− 3.8

SOURCE: National Science Foundation data from *Survey of Graduate Student Support*. Comparable data provided by 2706 academic departments. Data include students in natural and social sciences and engineering but not in humanities or professional schools.

siders the rationale for federal fellowship and traineeship support, while the second section examines the feasibility of relying on loans as a major source of support for graduate students.

THE RATIONALE FOR FEDERAL FELLOWSHIP SUPPORT

Much of the public interest in subsidizing graduate education derives from the belief that such training yields national benefits not wholly captured by the people educated. These are manifest in a more productive labor force, economic and social leadership, and broad advancement of the culture. The existence of such benefits argues not for fellowship programs that cover only a fraction of all graduate students; rather, it argues persuasively for providing subsidies to graduate schools so that the charges to all graduate students will be less than the full cost of producing their graduate education. The charges imposed upon potential graduate students must not be so excessive as to discourage large numbers from enrolling in graduate school, thereby losing the potential social benefits from their advanced education.[2] (In principle, this goal could be accomplished by giving all students fellowships, but that would simply be an administratively expensive way to accomplish a reduction in net charges.) The rationale for selective fellowships, not available to all, must be one that distinguishes on the basis of some public purpose between those receiving grants and those excluded. Among the rationales that have been suggested are those associated with "social mobility," "specialized manpower and research requirements," and "merit." These are discussed in turn.

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[2] Although we believe that graduate education yields national benefits, precise measurement and evaluation of the magnitudes involved have not been possible. Judgments on tuition levels thus retain an important political dimension.

Social Mobility

Many people believe that undergraduate aid should provide access to higher education for needy students and by analogy that similar aid should be available to graduate students. Actually, the two situations are not wholly comparable. The reasons for giving graduate fellowships are different from those for giving grants to undergraduates. The rationale for giving grants to needy *under*graduates is based on the following:

1. the belief that if such students were treated like everyone else, if they faced the same tuitions and had the same access to loans, they would enroll and persist in college at a much lower rate than the rest of the population; and,
2. the belief that such differential enrollment rates would be undesirable because the sons and daughters of low-income families would be effectively barred from positions of high status, which would be filled disproportionately from relatively wealthy families. "Upward mobility," regarded as an important social value, would be effectively curtailed.

These two considerations justify basing grants to undergraduate students on their parents' economic positions. The purpose is to reduce the cost of college to young men and women from low-income backgrounds. Does this justification apply as well at the graduate level? Should we have a grant program based on the economic status of parents of graduate students?

The social mobility argument is weaker at the graduate level. First, it is plausible to argue that 17-year-old high school graduates, having had little contact with highly educated people, no contact with legitimate uses of credit, and no firm career plans might resist entering college unless they receive substantial grant support. With some exceptions to be noted subsequently, however, these arguments are generally less convincing in the case of 22-year-old, college-educated persons who have planned careers at least to the extent of having chosen fields for graduate study.

Second, even if college-educated students from low-income homes would fail to enroll in graduate studies because of a lack of grant assistance, the consequences of such a failure for mobility and poverty elimination are not necessarily adverse. College graduates are not likely candidates for poverty, and the difference in prospects for positions of high status between college graduates in general and graduate-trained persons is small. For the most part, then, the most that need-based graduate fellowship assistance can accomplish is to move some students from low-income backgrounds up a notch *within* the middle-to-upper middle income range.

Perhaps the most persuasive reason for not undertaking a large need-based grant program at the graduate level, however, is the difficulty, both practical and philosophical, of linking such aid to the comparative financial status of parents of graduate students. Many graduate students are in their middle or late twenties, are often married and have families, and are clearly independent of their parents. It is hard to see how a national program, modeled on the undergraduate Basic Opportunity Grant concept, could be applied fairly or uniformly given the wide age range of graduate students.

Minorities

One group for whom the above argument may not hold is disadvantaged minorities (blacks, native Americans, Chicanos, and Puerto Ricans). Part of their reluctance to enroll in graduate study is due, understandably, to the urge to earn money quickly that is common to many first-generation college graduates. Part of the reluctance is also due to cultural factors. Minorities largely attend colleges where graduate study is not encouraged, and they are often unfamiliar with careers based on graduate education and regard these careers as not open to them. Moreover, the stability of our society does depend in part on our making progress in raising the proportion of minority people pursuing certain careers for which graduate education is prerequisite, and only by increasing their numbers in the professions will we be able to tap a large reservoir of unused talent. Examples of two professional fields where minorities are underrepresented are medicine and college teaching. Unless the proportion of minority persons in these fields rises, our society will be worse off. This will be especially so if we continue to insist on affirmative action programs for college faculties, without ensuring an adequate supply of trained minorities to make such programs viable.

We are convinced that it is important for the federal government to play a role in providing financial support for minority group participation in graduate education. Preliminary investigation has revealed, however, that the precise mechanisms for making such support effective are not simple or obvious, and a separate report on this subject is planned for publication in 1974. That report should be considered as completing this section of the present report.

Specialized Manpower and Research Programs

In an earlier report, we argued for allowing the labor market to determine the allocation of labor and career training,[3] but there are instances where market forces will not produce the research and trained manpower in the volume and with the required characteristics in time to meet social needs. For example, the federal government may embark upon a large-scale program to develop alternative energy sources, requiring new clusterings of research talent and advanced training facilities. The long lag that would occur before market forces generated the necessary centers for research and training would impose heavy (and unnecessary) costs upon society.

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[3] National Board on Graduate Education, *Doctorate Manpower Forecasts and Policy*, *op. cit.*

In the past, purposeful efforts to combine a stimulus to research with training programs have been most prominent in the biomedical field. New areas of research—such as molecular biology, biophysics, and steroid chemistry—have been stimulated by federal grants, which provided in a single package funds for fellowships, specialized research equipment, research supplies and renovation of facilities, as well as salaries for research assistants, postdoctoral researchers, and for faculty. Such support, distributed on a competitive basis, is a powerful and efficient means for hastening the development of a field of investigation in order to create new centers of strength. This mode of support can be adapted to other areas.

There are now urgent pressures to produce information, ideas, and experts in fields where the knowledge and the trained people prerequisite to a solution do not exist. New knowledge and trained people are urgently needed to deal with the problems of energy supply, conservation and distribution; the full array of difficulties that afflict our cities, including special problems of urban housing and transportation, the problems of racial tension and conflict, and the delivery of health care. Obviously, more than new knowledge and trained people are needed to solve these problems, but they will not be solved without them. Government action is needed, as it has been taken in many fields over the past two decades with conspicuous success. Institutions of higher education have reacted and adapted to national needs as expressed through the actions of Congress in passing federal laws and appropriating funds.

Under these circumstances, a set of federal programs in specifically designated, limited areas is required which will give support to the research and advanced training base of the fields in question. In addition to stipends for graduate students and/or postdoctoral researchers, the grants would provide support for necessary research equipment, faculty salaries, supporting staff, and renovation expenses. To ensure that such federal programs are not overexpanded and continued too long, they should be given a definite time limit, subject to review. These special programs are not a substitute for the market, but are intended to smooth transitions and thus need strict time limits. A careful expansion of federal aid for graduate education and research in these critical areas, monitored carefully to ensure that needs are real and that the programs of federal aid are productive, is a necessary part of a national effort to deal seriously with urgent domestic concerns.

Several features of these programs should be stressed. First, the volume of federal dollars and the number of graduate students supported will fluctuate over time as the needs of society change. Second, since the rationale for such programs is based in part on the need for new knowledge, maximum flexibility in staffing the programs should be encouraged. In particular, the use of postdoctoral researchers in place of graduate students should be allowed, with the decision made at the program level. Third, funds for the programs and administration of the competitive award process would be lodged in the relevant mission-oriented federal agencies, e.g., the Environmental Protection Agency for environmental programs, NIH for health-related programs, the United States Department of Transportation for programs focused on problems of urban transportation systems. Fourth, the programs need not (and rarely would) lead to the development of new academic departments. Instead they would serve to bring together professors and graduate students well-trained in basic disciplines for purposes of concentrating on solutions to problems requiring an interdisciplinary approach. The goal is not to foster new (and faddish) Ph.D. programs that lack a base in solid, underlying disciplines, but rather to provide an incentive for well-trained individuals to work together in flexible structures that transcend departmental boundaries on problems requiring the insight of more than one discipline. Graduates of such programs could be expected to carry with them a problem-solving orientation and a respect for the contributions that several disciplines can make to such efforts.

These targeted research and training activities illustrate with particular force two principles underlying well-designed programs of federal support for graduate education. The first is the tightly interlocked nature of advanced education and research. The second is the need to provide funds, not only for student support, but also for the university which offers the advanced training. The students or postdoctoral researchers who can learn best and contribute most in special areas of research must be carefully selected on the basis of background, motivation and intelligence, and support funds must be available in the volume and with the timing required for the effective development of the total effort.

- We strongly endorse recent United States congressional action in appropriating funds to continue the NIH/NIMH training grant programs, which accomplish many of the objectives in the areas of biomedical research and health care of our proposed program. Continued funding of the training grant programs with modest annual increases and with continuous peer review of the individual grants would be, in our opinion, wise public policy.

For the new programs to be funded through other federal agencies we offer the following guidelines:

- The grants should vary considerably in size but average approximately $300,000 per year, with the expectation of 5-year funding, subject to review.
- With considerable individual variation, roughly 50 percent of the average grant should be allocated for graduate student and postdoctoral stipends (including tuition for the graduate students), and 50 percent for institutional expenses required to mount the new program. If the average graduate student received a $3,500 stipend and if tuition payments averaged $2,500, requiring $6,000 per graduate student, the average grant could support 25 graduate students per year. The use of postdoctoral researchers, with stipends averaging $10,000, would reduce the number of graduate students supported accordingly.
- Although the total volume of such grants would fluctuate from year to year as national requirements change, we anticipate that approximately 200 grants per year should be supported once all agency programs have been started. This would require annual expenditures of approximately $60 million and would support a maximum of 5,000 graduate students per year (less if postdoctoral researchers were employed).
- The grants should be phased in over a 3-year period, with roughly 70 new programs funded each year until a level of about 200 grants is reached. Expenditures in the first year would be $20 million, $40 million in the second, and $60 million in the third and subsequent years.
- Federal agencies that should find value in supporting such programs include (but are not limited to) the following: Atomic Energy Commission, National Science Foundation (particularly in the Research Applied to National Needs program), Department of Health, Education and Welfare (including National Institute of Education and United States Office of Education), Environmental Protection Agency, Department of Transportation, Department of Housing and Urban Development, Department of Labor, National Endowment for the Humanities, and the National Aeronautics and Space Administration.

Merit Awards

In addition to the previous two programs, a strong case can be made for a program of federal fellowships based on undergraduate academic merit. To ensure that the most intellectually gifted young people in each college graduating class have no financial barriers to attendance in the graduate school of their choice, to encourage their attendance, and to enhance the tone of both undergraduate and graduate education by providing recognition for high intellectual accomplishment, a limited number of portable "merit fellowships" can be justified. American society confers awards, from Presidential Medals on down, for outstanding performance in a great many endeavors. At present, there are few available ways for the United States to confer honors for excellence in undergraduate work, at least on a national level.[4] A nationally competitive fellowship program is a sensible way to convey the value and significance that the nation attaches to outstanding undergraduate academic achievement, while also ensuring that the very talented have access to graduate education.

The program that follows from this discussion consists of merit-based grants, of modest number and dollar amount, modeled on the existing NSF predoctoral fellowship program, but extended through the appropriate federal agencies to cover all academic disciplines. Although there is no scientific way to determine the proper number of awards required to achieve the purposes just discussed, the following are offered as guidelines:

- Approximately 2,000 new awards should be made each year for graduate study in any academic discipline leading to the Ph.D. or similar degree.
- The term of the fellowship should be three years with an annual award to the student of approximately $3,500. A cost-of-education allowance to be applied toward the cost of the student's education and accepted by the university in lieu of tuition should accompany each award.[5]
- The fellowships should be "portable," attached to the young scholar, allowing him or her to study in the graduate school of his or her choice.

The NSF Predoctoral Fellowship Program currently awards 500 new fellowships each year in the physical, biological, and social sciences. Under our recommendation, the NSF program would be expanded, and the concept would be extended to all academic disciplines by establishing a counterpart program at the National Endowment for the Humanities. The distribution of fellowships between the two agencies should be governed by the size and number of eligible disciplines under their purview. With approximately 800,000 bachelor's degrees awarded each year, 2,000 merit fellowships would represent roughly ¼ of 1 percent of this pool of potential graduate students. A program of this size, focused exclusively on quality, should be a permanent feature of federal support for graduate education, not fluctuating with changing labor market conditions.

The portability of prize fellowships is a matter of some dispute. It is entirely possible, in some fields, for nearly all the fellowship recipients to be concentrated in a few graduate departments. This would conflict with the often expressed goal of sustaining many geographically dispersed centers of excellence. Excessive concentration of brain power is not in the best interests of graduate education or of the nation. But the merit fellowship program is not an appropriate vehicle for reducing such concentration. Very able scholars should be allowed to pursue their intellectual interests wherever they see the greatest gain, which is consistent with the "free-choice principle" that we support in the selection of fields of study.[6] The valid concern for regional centers of excellence should be met by supporting graduate programs of high quality capable of attracting the best students, rather than by constraining student choice.

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[4] *Cum laude* degrees, commencement prizes, election to Phi Beta Kappa certainly provide some such honors, but they are, in practice, "local". Scholarships of a more "national" scope, such as Rhodes, Churchill, Luce and Watson are very limited in number.

[5] The cost-of-education allowance is discussed in greater detail in Chapter 6, p. 77.

Fellowships in a Second Best World

This section amplifies the limited number of special purpose fellowship programs recommended thus far. The programs we have endorsed provide a base for graduate support—an irreducible minimum. But these programs, even in combination, will aid only a small fraction of the expected number of graduate students, a much smaller proportion than were aided under federal fellowships and traineeships in the late 1960's.

For most of graduate education, federal student-aid policy cannot be discussed in isolation from research and institutional support programs at both the federal and state levels. Non-fellowship holders will have to finance their studies through research assistantships, teaching assistantships, and by loans and other forms of self-support. Our position on fellowships depends on how adequately public bodies maintain these other forms of support.

A fellowship program no larger than the one recommended in this chapter can only be endorsed provided that (1) research support grows sufficiently to maintain or expand the number of research assistantships, (2) state governments maintain or expand support of teaching assistantships, and (3) tuitions for graduate students rise no more than is compatible with reasonable debt levels for graduate students.

Reasonable here means reasonable in the eyes of the students—not so high as to discourage the enrollment of those able to both benefit from graduate education and contribute more productively to society with their graduate training. While lifetime earnings attributable to graduate education obviously play a major role in determining how much debt students will find acceptable, it does not follow that students will be willing to incur debts up to the point where their income gain is just sufficient to pay off their indebtedness. Student behavior is governed in part by attitudes toward risk and uncertainty that cannot be easily assessed *a priori* for purposes of policy determination. Thus, there is no valid way at present to calculate the amount that students should be willing to borrow, even though such calculations have been made.

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[6] National Board on Graduate Education, *Doctorate Manpower Forecasts and Policy, op. cit.*

If research support fails to keep pace with inflation or if the assistantship component of research funding declines, if states fail to maintain teaching assistantship levels, if student loan programs fail to be adapted to meet rising charges (see the next section), or if borrowing by graduate students is pushed to the point where significant numbers of able students are discouraged from continuing their education—then the proposed base fellowship program would be inadequate whatever its theoretical desirability under favorable circumstances. If several of these adverse conditions should materialize, the continued existence of quality graduate education would be in doubt, and, in that event, a significant increase in the number of federal fellowships would be necessary.

These considerations raise two issues of federal fellowship policy. First, there is a need for a standby capacity for federal fellowship support. In the long-run, this capacity should be flexible enough to accommodate whatever emergencies may arise. The fellowship program authorized under Title IX, Part B of the Education Amendments of 1972[7] should be kept on the books, to be employed in the event of significant cutbacks in other forms of aid or failures of loan programs to meet graduate student needs. Second, though the kind of breakdown that would warrant a massive increase in fellowships has not yet occurred, a series of policy moves, *already begun*, could bring about such a breakdown. Our report has previously discussed the decline in federal fellowships and in research support, and the next section examines several reasons why federal loan programs may not be able to pick up the slack in graduate assistance. To these we would add the projected reduction in number of veterans eligible for G.I. Bill benefits, the slowdown or decline in undergraduate university enrollments which may erode teaching assistantship support, and recent advocacy by several groups of accelerated advances in tuitions at public institutions (especially at the graduate level). If several of these events coincide in the next few years, a crisis is likely. With so many contingencies and so much at stake, careful and continuous monitoring of programs that support graduate education is essential.[8]

LOANS AS A COMPONENT OF GRADUATE STUDENT SUPPORT

We believe that loans are a sound component of a total package of support for graduate students. As a matter of policy, loans on reasonable terms should be encouraged, but within certain important guidelines which set limits on loans as a component of graduate student support.

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[7] U.S., Congress, Senate, *Education Amendments of 1972*, P.L. 92–318, 92nd Cong., 2d sess., 1972, Title IX, part B.

[8] This subject is discussed in greater detail in Chapter 7, pp. 81–83.

In fact, federally guaranteed student loans are increasing rapidly as a means of graduate student support. In 1969, 63,000 graduate students borrowed an average of $1,012 for a total of $64 million. By 1972, the number of graduate student borrowers had increased to 113,000 and the average loan increased moderately to $1,143 for a total of $129 million, double the 1969 level.[9] This increase helped to offset the sharp decline in federal fellowships and traineeship support.

The central policy question is whether there should be a substantial further shift towards loans as a primary source of graduate student support. If fellowship support is provided along the lines advocated in this report, loans would necessarily become more significant, but would remain part of a pluralistic and diverse system of student support.

The principles which should undergird loans as an element of graduate student support are these:

1. Loans should not be relied upon as a substitute for the fellowship programs outlined in this report, for we believe each of these programs has a sound rationale.
2. Loans should be a supplemental source of income for those eligible for fellowships.
3. For those graduate students who do not receive fellowships under an adequate fellowship program, as defined in this report, loans would be one major source of support, together with teaching and research assistantships, and family resources.
4. The university should know the mix of earnings, loans, gifts, and stipends available to each graduate student so that serious inequities among students can be avoided.
5. There should be a ceiling on the total indebtedness which students may incur. The ceiling should be high enough so that students can borrow substantial sums for graduate as well as undergraduate study, but low enough so that students will not be permitted to load themselves with an excessive long-term debt.
6. There should be continuing experimentation by individual universities with new forms of repayment, including extended time periods for repayment and methods for relating repayment to ability-to-pay as determined by earnings after graduation.

Deficiencies of the Federal Guaranteed Loan Program

Given these principles, existing loan programs are deficient in a number of important respects. First, in many parts of the country, federally guaranteed loans are difficult to obtain unless a student's family has established banking contacts. Graduate students are more likely than other students to live away from their parents and to be independent of them. Their own banking connections are usually not substantial.

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[9] Data provided by U.S. Office of Education, Division of Insured Loans.

Second, because the maximum interest rate charged to the student is fixed by law, the guaranteed student loan program is severely squeezed in tight money periods. Some flexibility was added in 1969 when new legislation allowed the government to pay supplementary interest (up to 3 percent per annum) to lenders. But judging by the events of the summer of 1973, this flexibility has not been enough to offset the unattractiveness of student loans in periods when alternative investment yields are rising.[10] The impact of the new secondary market for student loans (through the Student Loan Marketing Association) is, as yet, untested.

Third, the federal program permits a maximum annual loan of $2,500 and a debt total for combined undergraduate and graduate borrowing of $10,000.[11] These ceilings limit the number of graduate students who can finance a substantial portion of their education with GSL program loans. However, because the annual limits were lower ($1,500) in past years, most graduate students today probably have accumulated much less debt than the new limit allows; after a few years at the higher annual debt limit, the $10,000 total debt limit will begin to pinch.

Finally, under the 1972 Education Amendments, in order to qualify for subsidies under the federal loan program a student must prove "financial need" in the amount of the loan. The "need analysis" on which such demonstration is usually based is designed for younger, dependent students. Graduate students face major problems under this needs test. Some graduate students are likely to fail the test of independence and thus have their "need" reduced by an "expected family contribution," when such contribution is not, in fact, received. (Unsubsidized loans are, in principle, available for amounts in excess of calculated need, but such loans are rarely extended.) Moreover, to the extent that graduate students qualify as independent students, they face very stiff required contributions from their own and their spouses' assets and earnings. In fact, student-need analysis for independent students is very much a primitive art. No one knows what are reasonable expectations of contributions for such students. Arbitrary toughness has been substituted for the many years of experience needed to learn the needs of students.

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[10] During August and September, peak months for student loans, the number of student borrowers was down 33 percent in 1973 from the 1971 level, and loan volume was down 23 percent over the same period, reflecting both the "tight money" squeeze and the problems introduced by the "needs analysis" discussed below.

[11] Some states impose even lower debt limits.

Problems with Proposed Revisions of Loans Statutes

These problems of access and adequacy in the operation of existing loan programs are generally conceded, but many argue that fairly simple modifications in existing legislation would solve them. However, the needed modifications raise such complex issues that further substantial expansion of federally guaranteed loans for graduate students is an unrealistic expectation. Moreover, the lack of solid underlying research means that the changes will have to be made piecemeal. Accordingly, it will be some time before loans can offset further significant reductions in other sources of graduate student support.

One proposed modification is elimination of the interest subsidies in the loan program and removal of the ceiling interest rate, because the interest subsidy is an ineffective way to subsidize education, while the interest-rate ceiling diverts funds from student loans in periods of tight money. However, withdrawal of government-paid interest for enrolled students would make bank lenders less interested in student loans since the interest subsidy allows each bank to make one combined billing for interest to the federal government, rather than numerous individual billings to students. This effect might be offset by a removal of the interest-rate ceiling, but the fact is that no one knows how the flow of capital through the banking sector would be affected by such program changes. What is known is that the cost of loans to students would rise.

Several recent proposals suggest removing the dependence of GSL on commercial banks. For example, student lending could become mainly a functions of colleges themselves, with capital provided in large part by the Student Loan Marketing Association (Sally Mae).[12] Alternatively, the nation could move to a direct, government loan bank.[13] Many tough problems that have not been seriously studied would arise in carrying out such proposals: How would the interest charge be determined? Would all classes of students or institutional lenders be treated the same? The implementation of unsubsidized loans made primarily by non-banks is still some years off, and will only occur after a great deal more study.

While the 1973 *annual* loan limit of $2,500 is a reasonable maximum for graduate students,[14] the lifetime debt limit of $10,000 is clearly inadequate for graduate students. A special higher limit of up to $15,000 should be allowed for those who undertake graduate education, and this limit should be reviewed periodically. At the same time repayment periods of up to 20 years should be allowed in lieu of the present 10 years.

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[12] Some of these possibilities are discussed in D. Bruce Johnstone, *New Patterns for College Lending* (New York: Columbia Press, 1972), Chapter 6.

[13] See the Carnegie Commission's *Higher Education: Who Pays? Who Benefits? Who Should Pay?* (New York: McGraw-Hill, 1973), Chapter 14.

[14] Some people would argue that students should be able to borrow foregone earnings as well as direct costs, which would raise the annual limits to the $9,000 zone. Clearly, this question is interrelated with the matter of whether the loans are subsidized and with what happens to tuitions.

Lifting the debt limit and permitting lengthier repayments would lead, however, to a number of unresolved policy issues. One is that existing reliance on commercial bank lending could not continue because banks complain that even the existing 10-year term is too long. Second, if only those who incur debts above some limit can have a lengthened repayment term, rules will have to be established to determine which lender must consolidate and rewrite the loans. Whatever the arrangements might be, the extension of loan repayment terms would require a substantial revision of the institutional arrangements that now exist in the federal guaranteed loan program, and this will take time.

Finally, loans can be made a more acceptable means of financing graduate education by reducing the apprehension of borrowers that repayment may impose too much of a burden on them in years of low earnings. This can be accomplished in a number of ways. One way is to allow the annual loan payment to vary in amount depending upon the income earned each year. We endorse experimentation with such plans, as advocated in the report, *Higher Education: Who Pays? Who Benefits? Who Should Pay?* of the Carnegie Commission on Higher Education.[15] The loan programs in operation at Harvard, Yale and Duke share this feature, and it is hoped that additional universities will undertake such programs until a national plan is implemented. Realism dictates, however, that such private plans not be viewed as a major source of loan funds.

A more radical departure from existing loan programs would reduce the risks of investment in education even further by allowing partial cancellation of repayment obligations for low earnings borrowers. The Yale plan involves this feature, mutualizing the risk across the cohort of Yale borrowers. The Carnegie Commission has recommended a similar provision in the event of catastrophically low earnings, with the amount forgiven covered by public subsidy.

If the federal government is eventually to endorse some kind of risk reduction program for borrowers, it will have to settle the questions of institutional versus federal programs, the degree of risk insurance to provide, and the proper locus of subsidization for unsuccessful borrowers. These issues are difficult to resolve. They have received little serious study or debate, and since it is unrealistic to expect any early resolution of these questions, even income-contingent loan plans with some element of federal support cannot be seriously considered as a source of substantial additional loan funds for graduate students in the foreseeable future.

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[15] Carnegie Commission, *Higher Education: Who Pays? Who Benefits? Who Should Pay?*, *op. cit.*, pp. 118–121.

In summary, federal loan programs have been able to fill gaps in student need during the past few years. But without modification, these programs cannot continue to meet growing student needs. This means either that the loan programs must be changed or that other forms of aid must bridge the gap. Most of the modifications to existing loan programs that would be necessary to make them effective forms of aid to graduate students have been inadequately studied. Many key policy issues need analysis and resolution before changes can be made. Moreover, the basic question of how much indebtedness graduate students should be expected to incur must be resolved. We recommend the following:

- Establishment of a commission to review the applicability of federal loans to support graduate students and propose answers to questions raised in this report. The commission should specifically consider the loan proposals of the Carnegie Commission.
- Amendment of the Education Amendments of 1972 in the light of these recommendations, with immediate increase in the debt limit up to $15,000 and the repayment period up to 20 years for graduate students.
- Continuing experimentation by individual universities with programs designed to lessen the burden of borrowing and to reduce the risks incurred by graduate student borrowers.
- Continuing experimentation by individual universities with methods for taking financial need into account when designing financial aid programs for graduate students.

5 Federal Policy toward Academic Research

To many Americans, the role of research in higher education is a mysterious one. Some think of research as a frill in which professors indulge late at night; others regard it as something that constantly produces miracles, like the Salk vaccine; still others think of it as a competitor for teachers' time, working to the disadvantage of undergraduate students. There is, of course, some truth in all of these descriptions but as estimates of the true purpose of research they are really quite wide of the mark. An attempt to clarify what research is and how it fits into the higher education process is therefore in order.

Research is the attempt to find new knowledge and new perspectives building on old knowledge. Broadly defined, it includes not only scientific investigation and technological development, but also scholarship, artistic and social criticism, philosophical reflection, and creative art. It occurs not only within the natural sciences and engineering but also in the social sciences, humanities, and fine arts.

Research may continue to lead to technological breakthroughs that have produced the transistor, the birth control pill, and nuclear power; it may lead to new insights about the meaning of life; it may open up new vistas for social reform; it may help to overcome problems such as unemployment or heart disease; or it may produce new forms of art.

The results of research may or may not be "useful." All research is risky in the sense that outcomes are uncertain. Some projects may turn out to be dead ends and lead to no significant results, while others may produce interesting knowledge but no useful outcomes. At the opposite extreme, some research—consciously undertaken only to satisfy curiosity or to advance knowledge for its own sake—may ultimately yield spectacular payoffs, as was the case when research showed us how to split the atom.

Sometimes research is undertaken simply because an investigator is curious about something, and sometimes because there is a need for new knowledge, for example, a cure for cancer. Some research is designed to advance knowledge and the arts for their own sake, thus providing indirect benefits–enriching the culture and adding meaning to human life. Some research is highly organized and heavily funded; some is done by individuals with minimal financial support. The United States spends many billions on research, and this is one reason why technology improves every year in this country and why it remains competitive with other advanced industrial nations. If people in the United States were as assiduous in advancing knowledge in the social sciences, the humanities, and the arts as they are in the natural sciences, United States culture might advance as rapidly as its technology.

RESEARCH AND HIGHER EDUCATION

Research is conducted in private industry, in governmental agencies, in nonprofit research and cultural organizations, in colleges and universities, and to a small extent in private households. As shown in Table 8, universities and colleges account for only a little more than 10 percent of the total research and development effort. Universities and colleges, however, dominate the national basic research effort. Though the distinctions between basic

TABLE 8 Estimated Expenditures for Research and Development, United States, 1972, by Performer

	Expenditures for Research and Development, $ million			
	Research			
Performer	Basic	Applied	Development	Total
Federal government (intramural)	578	1,579	2,323	4,480
Industry	660	3,545	15,335	19,540
Universities and colleges	2,542	612	126	3,280
Federally funded R & D centers associated with universities	285	230	254	769
Other Nonprofit institutions	245	526	310	1,081
TOTAL	4,310	6,492	18,348	29,150

SOURCE: National Science Foundation, *National Patterns of R & D Resources* (Washington, D.C.: U.S. Government Printing Office, 1973).

and applied research are not clear-cut, it is fair to say that basic research (investigation directed toward the advancement of knowledge without regard for immediate practical applications) underlies all later applied research and development.

Since the payoff from basic research often comes years after the initial research has been done, basic research can be neglected for a short time without adverse consequences for the culture or the technology. A nation might live for a short time on the intellectual capital derived from past research, and the result of neglect may not be immediately discernible. But, if the neglect persists, adverse consequences are certain.

One of the major issues in federal policy concerns the role of universities in research and the degree and kind of research support, on a substantial basis, that is necessary to foster sound cultural and technological development. Since universities are the locus of most of the basic research in the United States, ensuring their ability to perform adequately becomes a major national objective.

Higher education contributes to total research to the degree that it does in the United States simply because it employs many highly trained men and women on its faculties who have been exposed to research in the course of their training, are motivated to discover new knowledge, and have the needed skills. Of course, not all of the half million or so higher education faculty actively conduct research, but that activity is critical to first-rate training of the coming generation and to the continuing advancement of our knowledge.

Higher education is by no means a homogeneous affair, and research activity is important for only a part of it. For example, in the rapidly growing community colleges, research in the disciplines—while undoubtedly of interest to some faculty members—is not integral to the enterprise. Similarly, in the 4-year institutions, research may not be emphasized, although it is an important activity of most faculty members and of many junior and senior honors students.

It is in the universities with substantial graduate programs, however, that most academic research takes place. Our attention in this discussion of graduate education and research will center on those universities—public and private—which offer the Ph.D. In 1972, these universities accounted for 96 percent of all externally funded academic research.[1] It is worth examining the operation of these institutions where the role of research is central.

First, the major graduate centers are constantly producing new knowledge. They constitute one of the most significant collections of highly trained men and women with access to laboratories, equipment, libraries, computers, museums, and other facilities and who are in contact with numerous colleagues throughout the world. In consequence, the major graduate centers are a principal source of much of the progress of our economy and culture. It would be difficult to overemphasize the importance of this continuous flow of new knowledge.

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[1] National Science Board, *Science Indicators 1972, op cit.*, p. 40.

Second, graduate faculties must engage in research if they are to be effective teachers. Most doctoral students are bright and dedicated and are operating in their studies at, or near, the borders of what is now known. Unless their instructors are actively engaged in producing this knowledge, they cannot be effective teachers. This is a stage in the learning process where books cannot be relied upon. What is being learned and taught is not yet in books or laboratory manuals. An understanding of the close relation of research and graduate instruction, incidentally, suggests how irrelevant is the notion that research detracts from teaching by taking time that professors would otherwise give to the classroom. Research and teaching are part of the same process at the graduate level, and indeed to a considerable extent at the undergraduate level, for many members of the graduate faculties also teach undergraduates.

Third, much research is a product of the teaching process. Graduate students—particularly when they are preparing Ph.D. dissertations or conducting laboratory experimentation in preparation for the Ph.D.—are in fact doing research. Faculty members work with them in this process both supervising and collaborating. Research, in this case, is part of teaching and part of learning for both faculty member and student. A recent study suggests that some 60 percent of basic research results in chemistry, as measured by journal publications, is produced by graduate students in the course of working for their doctorates. This is less true in the humanities and social sciences but the difference would be one of degree rather than of kind. We emphasize these points to make it as clear as possible that research not only has a major role to play in graduate education but is a part of the process itself. While research can be carried on outside of graduate education, the converse is not true: Graduate education cannot be conducted without research.

THE INTERESTS OF THE PARTIES

Two considerations dominate any discussion of federal policy toward university research:

1. the central role of research in graduate education, as discussed above, and
2. the fact that the federal government, operating through the various agencies of the United States executive branch, is the single most important source of funds for university-based research.

The historical sketch in Chapter 2 contrasted the federal mission-oriented agencies, which "purchase" research results from the universities when such findings contribute to the agency's mission, with the national foundations, such as the National Science Foundation, the National Foundation for the Arts and Humanities, and—to a considerable extent—the National Institutes of Health, which embody the explicit commitment of the federal government to support basic research. The distinction between applied and basic research is not always sharply drawn. Nevertheless, after allowing for definitional problems, it is quite clear that the purposes of the federal agencies and of the university research community are not always identical. This is not to say that both sides do not gain when a contract is signed or a grant is made; they clearly do or the contract or grant would not be made. But there is an overlapping rather than an identity of interests, and it is important to understand the areas of divergence. The university is interested in the flow of research funds from the government to the faculty members, a flow which assists the university in financing individual faculty members' research. The point was made earlier that research is an integral part of the university's operation. Therefore, if there are no external funds available, resources for research will be limited (with serious negative results), or diverted from other important activities. In recent years, well over half of university research funds have come from the federal agencies and—given the fact that universities are hard pressed financially—if that flow were not there, graduate education would virtually cease. To the university, these funds are the life blood of a central function.

The federal mission-oriented agencies, on the other hand, are trying through the purchase of research to get answers to questions that will help them perform their assigned tasks, and they view the university simply as one source of expertise. To put it starkly, the university relies on federal research grants and contracts to maintain viable and productive research programs, and the government needs valuable and practical results. In happy circumstances these needs coincide, but research is the most uncertain of occupations and circumstances are not always happy.

Finally, we should remember that universities regard research not only as something that generates new knowledge for society, but as an integral part of the education process. Research funds enable the university to have graduate students, and graduate students teach undergraduate students. Research funds, therefore, make the teaching wheels go around and train research workers in the process. The federal agencies, on the other hand, are largely indifferent to these by-products.

Most of these differences in view are unimportant so long as research funds are in ample supply. A growing flow, as happened in most of the 1950's and 1960's, effectively submerges the divergence in the interests of the parties. But they come out of hibernation when cuts are imposed, and that is the heart of the difficulty we are now experiencing.

SOME CONSEQUENCES OF REDUCED SUPPORT FOR UNIVERSITY RESEARCH

The recent leveling off in the flow of federal funds for research documented in Chapters 2 and 3 will not be lethal to the universities,[2] but it does create serious problems. Within an aggregate that remains fairly level, substantial shifts are taking place. These are difficult to detect given the quality of available data, but we do know that they are creating problems. Universities have great difficulty in responding to rapid expansions or rapid contractions in any given part of their organization. Many of the things that limit their flexibility are the same things that make them great. For example, when shifts away from the natural sciences into the social sciences take place within an overall level amount of funding, universities simply cannot make sociologists out of chemists (except, in the very long run, when chemists either retire or find other employment, thus freeing funds for hiring sociologists). This sort of shift is underway at the present time, with sociologists and psychologists largely on the beneficial end and physicists on the losing end. In a period of overall rising support these adjustments are easy to make; in a period of level support they are not.

Another unfortunate impact of the leveling off of the flow of funds is that it becomes nearly impossible to maintain certain departments at levels large enough to retain their excellence. In highly professional research and teaching, there is a critical mass represented by the number of specialties within a particular discipline. Failing to achieve that critical mass, the discipline cannot become or remain a center of excellence.

Similarly, in order to maintain excellence, it is essential that new young people continue to enter each academic field. These people bring new ideas, new techniques, and new attitudes which ensure continued vitality, and ways must be found during the forthcoming period of slower growth to ensure that young scholars can continue to enter the academic and research professions. A close observer of the graduate scene has summarized this problem as follows:

> If academic research budgets continue to level off, grave questions of policy will be posed. The vigor of a scientific field seems to depend on a continuing injection of new investigators with fresh ideas and on sufficient funds to exploit new ideas and replace outmoded equipment. Controlled thermonuclear research provides an interesting model of what happens in a field in which support has stagnated. In a few short years, the United States has lost the commanding leadership it enjoyed in high temperature plasma research.[3]

[2] Of course, the potential loss to the nation cannot be measured.

[3] Harvey Brooks, "The Future Growth of Academic Research: Criteria & Needs," in *Science Policy and the University*, ed. by Harold Orlans (Washington, D.C.: Brookings Institution, 1968), p. 75.

In sum, developments on the research front in the universities are not as yet catastrophic. Universities can and should adjust to changes that may be necessary from time to time. The mission-oriented agencies cannot be expected to place the welfare of institutions that do their research above their own mandate to conform to national anti-inflation policy. But recent reductions in levels of research support coming at a time of inflationary increases in costs have placed many universities in a tight financial squeeze and have endangered the levels of achievement of the 1960's. A clear danger signal is evident. Problems that may become exceedingly critical have begun to appear, and if further signficant reductions in research support take place these problems will become acute. American universities have a unique research capability which has emerged largely as a consequence of the partnership between the federal government and the universities. This unique quality, which is one of the keystones of national achievement, should not be impaired.

A PROGRAM

Under these circumstances, and within these apparent constraints, are there options for federal policy that will serve the public interest better than others? We think that there are. For the reasons stated in this chapter, we believe it is in the public interest to maintain a viable academic research establishment, and this requires continuation of public funding. Since the mission-oriented federal agencies cannot be expected to spend their scarce funds in order to maintain the general welfare, we believe this function should largely devolve upon the National Science Foundation and the National Foundation for the Arts and Humanities, whenever federal research funds in the aggregate are in the process of contraction. In other words, these agencies, which in a sense are already charged with maintaining the viability of the nation's basic research, should assume that obligation more explicitly, with their research grants expanding when necessary to stabilize the flow of research funds. When other federal agency research funds are declining, theirs should be increased and distributed with an eye to the health of the total research effort.

The question remains as to how much of our resources as a nation ought to be devoted to research. Unfortunately, there are few definite guidelines to determine the "optimal" allocation of resources to research, in large part because the outcomes are inherently uncertain and often remote. When a successful breakthrough is made, however, the benefits are often enormous. Faced with this type of uncertainty, the "right amount" is necessarily a matter of judgment. (An international comparison of expenditures for R&D as a percentage of GNP showed that over the 1967–1971 period the ratio had declined in the United States, France, and the United Kingdom, but had increased in the U.S.S.R., Japan, and West Germany.)[4]

- Because we believe that research is the indispensable foundation of the nation's economic and cultural development, as well as a principal determinant of the future quality of life, we recommend that funds for basic research grow, *at a minimum*, at the same rate as the growth of GNP.
- To implement the preceding recommendation, whenever the basic research expenditures of the mission-oriented agencies decline, the budgets of the National Science Foundation and the National Foundation for the Arts and Humanities should increase to maintain the stable growth of basic research, as discussed above.

In addition, the research budgets of these two national foundations should not decline during periods of expanded basic research expenditures by other agencies, but should be increased annually by a rate at least equal to, or greater than, the growth rate of GNP. Because the National Foundation for the Arts and Humanities is a relatively new agency, its annual budget increases would be expected to be considerably more than the rate of GNP growth for several more years, as has been the case in the past.

To smooth out the annual changes in basic research expenditures that would occur under this guideline, a 5-year moving average annual rate of change in the GNP should be used.

These recommendations, if acted upon, would go a long way to ameliorate some of the present problems, but a number of other issues remain and should be mentioned. Thorough investigation and discussion of these longer-run questions is required before specific policy recommendations on these issues can be made.[5]

1. *What should be the relative priorities in federal support among the natural sciences, social sciences, humanities, and the arts?* Apart from areas of obvious and urgent economic and social concern, the nation must sustain scholarly inquiry in all fields as part of the obligation and opportunity of a civilized society to examine itself, review its history and cultural heritage as well as that of other societies, study the nature of man, the nature of society and government, and the relationships between the two. The welcome increases in funds for the National Foundation for the Arts and Humanities are evidence of the need for breadth and depth of scholarly inquiry and creative effort in all fields. The ideal would seem to be a moderate, stable

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[4] National Science Board, *Science Indicators 1972* (Washington, D.C.: U.S. Government Printing Office, 1973), p. 3.

[5] Part of this section was drafted with the helpful assistance of Harvey Brooks of Harvard University. He, however, should not be held responsible for any of the specific suggestions presented.

rate of expansion in all fields of inquiry, but the issue of research priorities clearly requires continuing investigation.

2. *What should be the relative emphasis on basic and applied research?* The distinction between these two is not sharp but is nevertheless meaningful and important. Basic research is the foundation or precondition of applied research. The total basic research effort provides the base without which the practical problems of the future cannot be solved. Decisions concerned with the absolute and relative expenditures for basic research are decisions on how much the nation wishes to invest in the future. The basic research being done today will put the nation in a position to attack important practical problems 10 to 20 years hence. In recent years, there has been a relative shift in federal support from basic to applied research and from the grant to contract form of support as agencies have tried to achieve quick payoffs by relating research more closely to immediate societal problems. This shift has occurred even in the National Science Foundation. This trend needs continuous review lest the flow of new basic knowledge, without which applied research is ultimately helpless, be dried up.

The real-and-present danger is that the urgency of current problems will lead to an underestimate of the seriousness of problems to be encountered one to five decades in the future, and to an incorrect assessment of the value of basic research and of the level at which it should be supported. The absence of growth (in real terms) of federal expenditures for basic research in colleges and universities since 1968 is an ominous development. Our recommendation above, if followed, would assure a stable growth of basic research expenditures, but whether this will be sufficient is a subject in need of further study.

3. *What should be the long-run role of the universities in research?* In the United States, research and graduate instruction are closely coupled. In some countries, the linkage between instruction and research is less close than in the United States, with universities concentrating on instruction and separate institutes specializing in research. On the basis of past performance in both graduate instruction and research, a strong case can be made for the United States model, i.e., maintaining the present role of universities in research with the concomitant close linkage between research and instruction. On the other hand, the possibilities for decoupling the two processes merit discussion and experimentation so that increased demand for research need not automatically result in increased Ph.D. production.

6 Institutional Support

A third major category of federal aid to graduate education and research is institutional support. The distinction between support of students and research on the one hand, and institutional support on the other, is not sharp. For example, when fellowships and traineeships are awarded to particular institutions, these represent a form of aid to those universities. These federal grants aid the university in recruiting capable students, and relieve pressure on its own student-aid funds. In addition, tuition paid by the student recipients flow to the institutional treasury. Similarly, research grants or contracts assist in institutional development by financing new equipment and additional faculty and staff, by enriching the educational environment for both students and faculty, by providing aid to students through research assistantships, and by relieving pressure on institutional research funds. Categorical grants designed for specific purposes such as student aid and research may sometimes lead to unbalanced growth of universities; there is no doubt, however, that they do encourage institutional development and, in that sense, represent institutional support. Moreover, imbalances can sometimes be partially corrected through the internal budgeting process of universities, especially in a time of broad general growth. Grant funds infused into the one department may enable the university to shift some of its own funds to other departments.

At the opposite extreme from categorical grants are the general unrestricted institutional grants available to all institutions. When the funds are provided in this manner—without selection of institutions and without designation as to how they should be spent—their effect on graduate education will depend upon the internal decision-making process within universities. Such aid is likely to be diffused widely throughout the institutions and, therefore, to affect graduate education and research only indirectly.

Between the two extremes are federal institutional grants which might be called semicategorical grants. These are neither designed for narrowly specific categorical purposes nor are they distributed unselectively to all institutions of higher education. Included in this group are grants to institutions supplementing awards of fellowships and traineeships; grants supplementing research awards; grants or subsidized loans for building construction; and grants specifically designed for broad development of graduate study, scholarship and research in institutions.

This section will be concerned primarily with semicategorical forms of institutional support as they relate to graduate education.

FEDERAL POLICY

For a variety of reasons, not all of them consistent, the federal government has been conservative or reluctant in its use of institutional support. Federal policymakers have tended to favor forms of aid that will produce specific results closely related to federal administrative responsibilities in defense, space, agriculture, etc., and that are clearly vested with the national interest in a way easily explained to the public. They have tried to retain considerable control over the use of the funds and to impose fairly strict accountability. The federal government has generally avoided the kinds of institutional aid that would involve such wide dispersion of funds that direct results could not be identified, and has leaned toward support of excellence. Policymakers have intended that the federal contribution should augment the contributions of the states and the private sector and not substitute for them. In addition, recent policy has placed higher priority on opening up opportunity for students through student aid than on the support of institutions. Many federal officials have expressed the belief that unrestricted institutional aid would not be the most effective way to increase opportunity for students or improve quality of instruction and research. For all these reasons, having varying degrees of plausibility, the federal government has tended to concentrate its efforts on student aid and research, proceeding in a more limited way in the field of institutional aid.

This posture has been tenable on the assumption that someone else—the states, local municipalities, private donors, and tuition-paying students—would provide adequately for the basic operation of the institutions. It has been based on a rough division of responsibility in which the federal government would provide substantial support for students and research, and certain other fairly limited forms of aid to institutions, while primary responsibility for the institutions would come from other sources. More recently, another concept underlying this policy has been that revenue sharing might eventually be a vehicle of federal assistance to states and localities in bearing their higher educational burden.

Out of these many considerations has emerged present federal policy. Chapter 2 outlined the development of federal support; the resulting distribution of federal funds for graduate student support, research support, and institutional support connected with graduate programs for FY 1972 is displayed in Table 9. These data show that the majority of federal support has been categorical aid for students and for research, with only 7.2 percent available in the semicategorical form of institutional support described above.[1]

TABLE 9 Federal Funds to Universities and Colleges for Graduate Education and Research by Program and Type of Support, Fiscal Year 1972

Category of Funds	Federal Funds to Graduate Education and Research, FY 1972, $ million Student	Research	Institutions	Total
Fellowships and traineeships	113.9			113.9
Training grants	67.6		69.3	136.9
Work-study (CWSP)	10.9			10.9
G.I. Benefits	210.0			210.0
Research and development		1,788.0		1,788.0
General science support			67.0	67.0
Loans:				35.0
Direct student loans (NDSL)	17.2			
Guaranteed student loans (GSL)	17.8			
Capital (R & D plant)			36.9	36.9
TOTAL	437.4	1,788.0	173.2	2,398.6

SOURCE: Appendix Table A.13.

Federal policy in support of graduate education, scholarship, and research raises a fundamental question about the locus of decision-making. To what extent should it be lodged in federal agencies and to what extent in the universities? Categorical aid tends to place the decisions in the agencies, whereas aid in less restricted forms tends to place the decisions in the universities.

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[1] Cost-of-education allowances accompanying fellowships and traineeships and tuition payments accompanying training grants are included in the student support figures. Research assistantships are included in the research support figure. Federal funds for semicategorical institutional support were considerably larger in fiscal 1968. See Appendix Table A.13.

In the area of research, the university is the principal place in our society where ideas can be considered for their own sake and where there are few restrictions imposed by the need for practical results. As discussed in the previous chapter, this kind of unprogrammed, pure research turns out to be immensely practical in the long run, serving as the fountainhead of most of our scientific and technological progress. Emphasis on outside decisions, often motivated by short-run considerations, tend to weaken decision-making within the university, and may, if carried too far, impair the national research effort.

In the area of graduate student support, the same considerations apply. Decisions about which fields and specialties to support may be made by the agencies through forms of student aid designed to meet specific projected manpower needs; or they may be made through the relatively free choices of students, who are influenced by values internal to the university, by advice of professors, and by labor market considerations. Excessive emphasis on outside decisions—especially in view of the parlous state of manpower forecasting—can warp student choices just as much as excessive reliance on uninformed free choice may lead to imbalance.

The goal, of course, is balance—between outside and inside decision-making, for both research and graduate education. To achieve this balance is perhaps the most critical problem of American higher education today. Many observers believe that faculties and administrations have traditionally had excessive decision-making power and that universities have not been sufficiently responsive to social needs. A two-pronged effort has been launched in recent years to strengthen outside influences and thus increase the social responsiveness of universities. One approach has been through political means such as increased intervention by governors and legislatures, creation of statewide coordinating agencies, and imposition of specific conditions for federal aid. The other has been to introduce stronger elements of the price system into the financing of universities.

Under an extreme version of the price system, universities would price their instruction to students at or near full unit cost; students would be financed independently of the universities; universities would sell their research on contract to government and business, and their public services in the market. Under this system, universities would depend for their existence upon meeting outside demands and, thus, become totally dependent on the dictates of the marketplace. At the opposite extreme, universities could be financed entirely by unrestricted appropriations, gifts, and endowment income, controlling all their own student aid funds. In this system, decision-making would [illegible] largely with the faculty and administration, though it would be broadly responsive to outside sources of funds so that appropriations and gifts would keep flowing. We believe that the desirable distribution of power lies between the extremes of the price system and total support in the form of unrestricted funds. The history of higher education, however, strongly supports the view that some degree of academic self-determination, reinforced by substantial unrestricted funds, is conducive in the long run to the advancement of learning and to the sound education of students. It would be hard to find a university where academic greatness has been associated with continuing and heavy-handed outside control. The importance of academic self-determination is sometimes overlooked in the present contest for control of the university.

All of these considerations suggest that federal policy for graduate education and research should be directed toward balanced institutional development, academic self-determination, and stability as well as toward training specific types of learned persons and advancing particular branches of knowledge. *We believe that the division of responsibility for higher education which has been evolving over the past 25 years is fundamentally sound, namely, that the states and the private sector assume responsibility for basic operation of the institutions and that the federal government assumes increasing responsibility for the financing of students, research, and selected institutional programs in the national interest.*[2]

Since the institutions are the prime source of both graduate education and basic research, the quality of the future product depends upon their essential soundness as centers of learning. Thus, a perennial question remains: To what extent should the federal government give support to broad institutional development as a supplement or an offset to its categorical programs?

POLICY OPTIONS

There are many ways of providing general institutional support for graduate education and research. The following are examples:

1. totally unrestricted support for all institutions of higher education, regardless of their role in graduate education and research (only a small part of such aid would flow into graduate education and research);
2. totally unrestricted grants awarded only to institutions engaged significantly in graduate education and research;

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[2] The Carnegie Commission on Higher Education has endorsed this division of labor between the federal government and the states. See *Institutional Aid: Federal Support to Colleges and Universities* (McGraw-Hill, 1972), p. 2, and *Higher Education: Who Pays? Who Benefits? Who Should Pay?* (McGraw-Hill, 1973), pp. 8, 106.

3. grants awarded to all qualified institutions subject only to the restriction that the funds be used for graduate education and research;
4. relatively broad grants but awarded (1) with conditions relating, for example, to program, institutional quality, geographic area, size of institution, enrollment of minority students, or scope of research effort; and (2) with restrictions on the use of the funds, for example, to support research, to support graduate study, to provide fellowships, to purchase equipment or to strengthen faculty.

This fourth category illustrates that the demarcation between institutional aid and categorical grants is not a sharp line. Determining when a grant is to be classified as institutional aid and how many conditions and restrictions will justify its classification as a categorical grant is arbitrary.

In providing general institutional support for research and graduate study, the federal government has additional choices other than direct grants to institutions. There are:

1. federal revenue sharing with the states in the belief that some of the shared funds would find their way to graduate education and research as needed; and,
2. incentive grants to the states to encourage state effort in the finance of higher education generally or of graduate education and research in particular.

The direct effect on graduate education of either of these approaches is likely to be attenuated because of general institutional needs or because programs with greater immediate appeal receive higher priority.

On the other hand, since the federal government has special responsibilities in the areas of graduate education and research, grants to institutions with certain conditions and restrictions are more likely to hit the target than are broad general grants. In fact, the federal government has for several years financed certain programs, described in Chapter 2, that provide institutional aid of this type. These programs include:

1. cost-of-education supplements of approximately $2,500/year accompanying most federal fellowships and traineeships. The total volume of these is declining as the fellowship and traineeship programs are phased out.
2. supplementary grants to institutions from NSF and NIH to help the universities deal with the rigidities introduced by heavy reliance on the project system of research support. These grants were being phased out by the administration, but Congress recently restored the NIH General Research Support Grants to a level of approximately $50 million for FY 1974. (See footnote 3, Chapter 1, for qualification.)

3. The NSF Science Development Program, which provided special grants to selected universities to raise the quality of graduate education in science from good to excellent. This program ended in 1972.

4. The NIH/NIMH training grants, which include a substantial institutional support component.

5. Funds for R&D plant and construction grants for graduate academic facilities. Funds under the latter program have not been appropriated since 1968.

In addition to these five forms of support, which have existed for a number of years but are generally being phased out or sharply reduced, two additional forms of institutional support were written into the Education Amendments of 1972. Both could affect graduate education, but neither has been funded. The first new form[3] would provide funds, upon application on a competitive basis, to institutions of higher education, "to strengthen, improve and where necessary expand the quality of graduate and professional programs leading to an advanced degree (other than a medical degree) in such institutions," and for other related purposes [Title IX, Part A, Sec. 901(a)]. The act authorized $30 million for this section for the year ending June 30, 1973, $40 million for the year ending June 30, 1974, and $50 million for the year ending June 30, 1975.

The second new form of institutional support, providing more general support for graduate programs, is aimed at helping institutions achieve "general educational goals and specific objectives of the graduate programs of the institution" (Title X, Part F—General Assistance to Graduate Schools, Sec. 981). This provision would base the grant upon the full-time equivalent number of students "pursuing a program of post-baccalaureate study." The actual amount awarded to each institution would depend on the operation of an extremely complicated formula providing general institutional support payments (called "cost-of-education payments," not to be confused with the cost-of-education allowances accompanying federal graduate fellowships) to all institutions of higher education. This provision (Title X, Sec. 1001) has not been funded.

A PROGRAM

Given this array of statutory authorities and administrative inventions, as well as others that could be proposed, we believe the following outline gives a reasonable program of support for graduate education in terms of function and magnitude for the period immediately ahead.

[3] Not literally new. The provision first appeared in the Higher Education Act of 1965. It was never funded, and was re-enacted with minor amendments in 1972.

Program Outline

- *Cost of Education Allowances* It should continue to be recognized that each student with a federal fellowship generates instructional cost substantially higher than the university's tuition; consequently, cost-of-education allowances now embodied in law and in administrative practice should be continued. The existing level of $2,500,[4] arrived at by administrative agreement among the federal agencies, was set more than a decade ago. It should be increased to $4,500/year, to reflect in part the rapid cost increases that have occurred during this period.[5] Since existing levels of federal fellowship support are low and declining and since this report recommends a modest level of federal fellowship support over the next few years, these cost-of-education allowances would provide a modest proportion of the cost of graduate instruction. These allowances should be reviewed and increased if costs continue to rise, in the same way that social security payments are reviewed and increased periodically.
- *Funds Complementing Project Support* The rigidities and lack of flexibility associated with the project-support system in the past indicate a need to continue to provide moderate institutional support funds to make that basically sound system operate most effectively. The administration's proposed phaseout of the NSF Institutional Grants for Science and the NIH General Research Support Grants ignores these needs. We strongly support the recent United States congressional appropriation of approximately $50 million for the NIH program, and recommend that this funding level grow modestly as research support increases. The current level of the NSF program ($6.9 million) should be increased to roughly $20 million in FY 1975 to restore the proportion of institutional-to-project support that prevailed in the late 1960's before the phaseout began.
- *Support for New, High Priority Programs* A separate need exists for institutional support funds in connection with socially urgent new graduate programs, as discussed in Chapter 4, "Specialized Manpower and Research Programs." In designing education and research programs, universities face the task of providing persons rigorously trained to solve such pressing problems as those of energy supply, the environment, health care delivery, mass transportation, urban centers, and stress and conflict in modern society. To speed the development of programs of quality and breadth, federal funds should be provided, on a competitive basis, to universities for the following: support of faculty and other professional staff, including graduate students and postdoctoral researchers; for laboratory equipment and supplies; for

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[4] Increased to $3,000 in 1972 for the NSF predoctoral fellowship program.

[5] Just to keep pace with the inflation that has occurred in the decade since the allowance was set at $2,500 the amount would have to be raised to $3,750. At current rates of inflation, the difference between $3,750 and $4,500 would be reached in less than three years.

special library collections; and for other resources required for new programs. The institutional support component of these programs would be similar to that associated with NIH training grants, with funds originating in the appropriate mission-oriented federal agencies. Details on dollar amounts recommended under this section are in Chapter 4, pp. 51–52.

- *General Institutional Support* Funding of the general institutional support provisions of the Education Amendments of 1972 (Title X, Sec. 1001) should be based on a separate assessment of the financial needs of postsecondary education totally, since the benefits of this provision relate more directly to postsecondary education than to graduate education explicitly. Because this report is focused on graduate education, and because the funds that would be allocated for graduate education under Title X could not exceed 10 percent of the total amount appropriated, we place higher priority on funding the preceding three programs at this time. Good graduate work, however, could not exist if undergraduate education in the nation's colleges and universities were impoverished. Therefore, serious consideration of the need for full funding of Title X, Sec. 1001, should have high priority in forthcoming United States congressional sessions.

Institutional Aid and Tuitions

A frequent suggestion to alleviate the financial problems of higher education, including graduate education, is to raise tuitions rather than increase public support. For example, the Carnegie Commission on Higher Education has suggested that tuitions might be graduated by level of instruction, with tuitions minimal for freshman–sophomore instruction, higher for junior–senior instruction, and still higher for graduate and professional instruction.[6] While modest annual increases in graduate tuition will undoubtedly be necessary for many universities, we are opposed to the large increases that have been advocated by some groups since such increases would have to be offset in large part by increased student aid if opportunities for advanced study are to be kept open.[7] This is especially so because many graduate students are self-supporting, are without aid from their families and are living on a subsistence basis. Furthermore, raising tuitions will not eliminate the need for institutional funds from other sources. The Carnegie Commission, in the same report in which it recommended higher graduate tuitions, also stated:

> We believe that over the coming decade the federal government must significantly increase its support of education in graduate and selected professional fields and of basic research if the nation is to remain in the vanguard of scientific and technological

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[6] Carnegie Commission on Higher Education, *Higher Education: Who Pays? Who Benefits? Who Should Pay?*, *op. cit.*, pp. 107–8.

[7] On this point, see the discussion in Chapter 4, pp. 47–48.

developments. Each of these is an area of clear national responsibility and cannot effectively be left to state and institutional action alone.[8]

A PHILOSOPHY OF INSTITUTIONAL SUPPORT

The philosophy underlying institutional support for graduate education is one of securing positive benefits from two principles that generate inherent tension and are inconsistent if carried to extremes. Both must be followed in balanced measure. The first principle is that the university must have a large degree of freedom if it is to do effectively for society what society demands of it. The integrity of the university as a center of learning depends on its having access to substantial amounts of relatively unconditional and unrestricted funds. Such funds enable the faculty and administrative staff to exercise professional judgment in matters of education and research, to budget in ways that will achieve coherence and balance among the various disciplines and activities of the university, and to build centers of learning rather than collections of disparate activities responding to signals from the outside market.

The second principle is that graduate education must be responsive to the needs of society, and this is incontrovertible. Given the power of graduate education and research to supply persons equipped to analyze pressing social problems and part of the new information and ideas without which these problems will not be solved, a failure to focus graduate education and research effectively on these tasks would be unwarranted and irresponsible.

The program outlined above is designed to reconcile these conflicting and equally valid principles. Cost-of-education allowances help the institution meet heavy costs, and those costs are met most effectively in institutions and fields selected by the students. This is useful, but not as the sole form of institutional support for graduate education.

The form of institutional support represented by supplements to research project grants is designed to sustain institutional flexibility within a research-support system which otherwise tends (1) to erode the freedom of the institution and (2) to make it unhealthily subject to federal agency program decisions which have little or nothing to do with the strength of institutions of higher education.

Funds awarded competitively, expressly for the development of research and training programs, are essential if graduate education is to provide trained people and competent analysis in the resolution of social problems. Such support is an outside influence on the course of graduate education, but, if supplemented by other forms of support which maintain a proper degree of institutional autonomy, it will be productive.

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[8] Carnegie Commission, Higher Education: *Who Pays? Who Benefits? Who Should Pay?*, *op. cit.*, p. 107.

7 Coordination of Federal Policies toward Graduate Education and Research

A major theme of this report is that the actions of the federal government have major effects upon graduate education. These effects fall into two categories: *direct effects,* intended by the Congress and by federal agencies which support graduate program and research to attain specific ends, such as the education of individuals required for a given field or the production of research in a specified area; and *cumulative effects,* repercussions of the actions of separate United States congressional committees and executive agencies upon universities as a whole, upon the total supply of and demand for trained manpower and upon the balance of functions performed by all universities combined. These latter effects are extremely important, but they come about as unintended and generally unmeasured consequences of the separate, limited actions of a number of substantially autonomous congressional committees and federal agencies.

The system of supporting graduate education and research by a number of federal agencies, each with its own purposes and devices, is essentially sound. It links the functions supported to social purposes, and this tends both to infuse a spirit of inquiry into government operations and to sustain research and development investments. It ensures diversity of purpose and method in federal support of graduate education and research. From the viewpoint of universities it has the great merit of providing numerous alternative sources of funds. It permits experimentation on a relatively small scale, and experiments which fail do not shake the whole system.

What is lacking is both a means for assessing the total federal impact on graduate education and for exercising reasonable influence over the direction of the effects. The origin of the difficulty lies in the virtual autonomy and lack of communication among a large number of United States congressional committees and federal agencies. This problem appears in many forms. It is now difficult to measure the effects of federal policies on specific fields of inquiry, or to take corrective action, if necessary. It is also difficult to foretell the effects upon a single university of the total activities of the federal government, and virtually impossible to take corrective action if by accident the cumulative effect of agency actions is to cut drastically the volume of federal funds to a university. There is no adequate means of ensuring reasonable stability in the operation of the system, so that either increases or decreases in funding levels do not generate waste and disruption.

IMPROVED INFORMATION AND ANALYSIS

More rational policies cannot be devised and operated unless there is a marked improvement in the quality of information and analysis related to graduate education and research. We strongly emphasize the need for improved information and analysis as a critically important first step in the long-run process of developing sound, flexible, and responsive policies to guide university–federal government relationships. The fact that this report and others do not contain a fully satisfactory factual base stems both from the absence of data and from the lack of any central point at which the relevant data collected by the various agencies are brought together and analyzed in a fashion useful for policymaking. This results in a situation in which no one has an overview, and almost any side of an argument can be supported by some partial set of figures or selected illustrations and rationales.

Critically important sets of facts are incomplete and often conflicting. For example, the types and amounts of support for graduate students are not known in the detail required for policy formulation.[1]

[1] A concrete example of this general problem will be useful. Since 1966, the National Science Foundation has collected detailed information from graduate science departments on the types and amounts of graduate student support available to each department. This survey began as an administrative report in connection with the NSF Traineeship program, and when that program was eliminated in 1971, funds to support this valuable and unique data base were slated for elimination. Thus far, the survey has been continued, but this has required a major struggle each year. And yet, this survey is the only existing source of detailed departmental information on graduate student support extending over several years, and would be essential to any study of the impact of student support on enrollments by field and university.

There is a further irony, however, in that the humanities are not included in this survey since they fall outside the scope of NSF concern. Comparable data for the humanities do not exist, and thus several important policy questions regarding the impact of federal student support cannot be readily addressed, for example, the question of whether the heavy federal student support in scientific disciplines during the 1960's simply had a displacement effect, allowing universities to shift internal funds to support humanities students.

As another example, official data on first-year graduate enrollment, a critically important indicator of current policies and a leading indicator of the size and composition by field of graduating Ph.D.'s four to five years hence, are not available until nearly two years after the fact.[2]

Among other questions important for policy decisions are these:

What effects have the cutbacks in fellowships and traineeships had on access to graduate education and on student decisions regarding the pursuit of advanced work in particular disciplines at specific universities?

Is the graduate education system adjusting in a rational fashion to a new environment of reduced support and diminished academic demand for new Ph.D's? Are graduate enrollments discipline by discipline adjusting in the proper direction in light of anticipated manpower needs five or more years hence?

What effects are the cutbacks having on the quality of graduate education, and on the ability of universities to respond to new program needs?

The deficiencies in the information system exist because no single agency in Washington has responsibility for a comprehensive overview of all graduate education, and the data collection efforts of the individual agencies are not coordinated in a unified fashion to provide this overview.

While this report cannot recommend how responsibilities should be distributed and coordinated, we can note the criteria for a sound solution. The requirements are *competence, objectivity,* and *political credibility.* In our judgment, the American Council on Education should convene conferences to discuss such matters as data requirements, requirements for analysis, priorities and time constraints. The discussion should produce a framework for analysis, and agreement regarding how responsibilities should be shared among specific private and public groups to secure consistent and timely data, including commitments on the part of specific groups to accept responsibilities as part of a system.

A continuing point for coordination is needed and this could be governmental or lodged in a private organization with federal financial support.[3]

[2] The United States Office of Education has responsibility through the National Center for Education Statistics for collecting these enrollment figures, but they become available with such a time lag that their value for policy purposes is seriously reduced. For example, at the time of this writing (October 1973), figures on enrollments for advanced degrees for 1971 have just been published, figures for 1972 enrollments will not be available for several months, and 1973 enrollments will not be known for over a year, far too late to be useful in debates over current policy. In short, the NCES statistics provide a useful historical account of trends in higher (and now postsecondary) education, but they do not provide the up-to-date information needed for policy analysis and determination.

[3] This subject was discussed in the National Board on Graduate Education report, *Doctorate Manpower Forecasts and Policy, op. cit.*, pp. 17–19.

Among federal agencies, the Office of Management and Budget, the National Science Foundation, National Foundation for the Arts and Humanities, or the Department of Health, Education and Welfare (including the National Institute of Education) should be considered. Possible private organizations for this task would include the American Council on Education, the Brookings Institution, or the National Academy of Sciences. Establishment of a new organization along the lines of a National Center for Postsecondary Education Policy Research as described in a recent article[4] should also be considered.

If the structural problems can be resolved, most of the problems that now exist in data collection and analysis would be solved, and resources would be used more effectively. The operation of an improved structure will require additional funds and, in our judgment, Congress would be wise to supply additional resources for an improved system.

COORDINATED POLICY IN THE EXECUTIVE BRANCH

Over the long run, we believe that a new Department of Education would provide the best answer not only to general policy problems related to graduate education and research in the executive branch, but also to other questions of equal or greater significance relating to all of postsecondary education. Since a large scale restructuring of functions now lodged in the Department of Health, Education and Welfare does not seem imminent, we suggest more modest measures.

The most effective place in the federal government at this time for a coordinating effort related to graduate education and research is in the Office of the Science Adviser, who is now the Director of the National Science Foundation. We urge that the Science Adviser call together the heads of the major federal agencies involved in support of graduate education and research to state the problems and propose solutions. The Federal Council for Science and Technology might provide the means for continuing attention to the problems, provided the National Foundation for the Arts and Humanities (as well as other agencies such as the Department of Labor which support substantial programs of research and graduate education in the social sciences) could be formally associated with the effort.

So far as graduate education alone is concerned, a logical point of coordination is the Assistant Secretary for Education in the Department of Health, Education, and Welfare. He is directed by Executive Order 11761, January 17, 1974, to "Exercise leadership in seeking timely resolution of differences of opinion concerning policies or administrative practices with respect to federal educational activities affecting educational institutions." The Federal Interagency Committee on Education, chaired by the Assistant Secretary, is available to assist him with this task.

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[4] Robert C. Andringa, "Why Won't Educators Help Congress Write Education Laws?" *Chronicle of Higher Education*, Vol. VII, No. 39 (July 30, 1973), p. 12.

COORDINATION IN THE LEGISLATIVE BRANCH

Responsibility for policy relating to graduate education and research is as dispersed in Congress as it is in the executive branch, and with consequences that are as adverse. The problem is complicated by the fact that both appropriations and substantive legislation must be dealt with by the Congress, and by the fact that both the Senate and the House are involved.

We support the current efforts in the Congress both to introduce a greater degree of systemization into the appropriations process and to redistribute committee assignments in both the House and the Senate to bring educational matters together more coherently in the House Committee on Education and Labor and in the Senate Committee on Labor and Public Welfare.[5] In addition, creation of a Joint Education Committee, with a role similar to the Joint Economic Committee, should be seriously considered. Such a committee would have an education and dissemination role in the Congress, highlighting problem areas as it should see fit, but not considering substantive legislation. A subcommittee of this new JEC would be concerned exclusively with graduate education.

DEALING WITH INSTABILITY

Measures for Dealing with Instability

The importance of stability and gradual change in federal funding levels for graduate education and research has been stressed. However, graduate education and research are relatively minor parts of programs whose funding is properly decided on grounds other than what is best for these activities. Occasional sharp changes in funding levels for federal programs must be expected. The problem is to insulate graduate education and research, so far as possible, from the disruptive consequences of these changes.

A number of measures should be used more extensively to deal with this problem:

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[5] For an interesting analysis and proposal along these lines for the House of Representatives see *Statement of the Honorable Albert H. Quie, Ranking Minority Member of the House Committee on Education and Labor before the Select Committee on Committees*, U.S. House of Representatives, May 18, 1973.

Grandfathering and Hold Harmless In a number of elementary and secondary education programs, Congress has seen fit, when altering distribution formulae or phasing out programs, to ensure that "losers" receive their losses in a gradual way, or that previous recipients of benefits continue to get assistance, although new starts are eliminated. This policy should certainly be followed for changes in policy with respect to graduate education.

Step Funding It is possible to arrange research grants and contracts so that termination is phased out in a planned manner over a period specified in advance. This "step funding" permits a gradual planned adaptation to reduction or cessation of support.

Stable Growth of Research Expenditures The budgets of the National Science Foundation and the National Foundation for the Arts and Humanities should be deliberately planned to accommodate the financing of high quality basic research which can no longer be financed by other agencies because of program changes. For example, when the Department of Defense decreased its support of general purpose basic research, much of which was of the highest quality, the National Science Foundation undertook to pick up the burden. In our opinion, a deliberate, continuing adjustment of the budgets of these two national foundations to permit them to offset reductions in the capacity of other agencies to finance basic research is indicated. (More detailed discussion of this proposal is contained in Chapter 5.)

Emergency Aid Discretionary sums of money can be set aside to assist institutions which are in extreme financial difficulty on a temporary basis. This has worked for medical schools, although the problem of assessing relative financial difficulty remains difficult. Provision for such aid is authorized in Title III of the Education Amendments of 1972, but has not been funded.

New Federal–University Relationships

Finally, the possibility of major institutional change in the relationship between universities and the federal government deserves serious study. While exploration of these questions is beyond the scope of the present report, we believe that such issues should be raised and subjected to public scrutiny. For example, variations of the British University Grants Committee (UGC) approach, which provides a single large block grant to each university over a 5-year period, should be explored. A UGC-type operation that would fund not the entire university but all graduate education activities could be considered.

Supplement

DIFFICULTIES IN COST ANALYSIS OF GRADUATE EDUCATION

The rapid expansion of higher education during the last 15 years and the associated increase in costs have produced widespread interest in techniques for analyzing costs of college and university programs. University administrators are seeking new methods for analyzing cost patterns to improve internal resource allocation, and state legislators and statewide coordinating agencies are searching for uniform costing procedures to permit comparisons of costs across programs and institutions. Graduate education, with its high program costs, has come under particular scrutiny. More recently, in creating the National Commission on the Financing of Postsecondary Education, the United States Congress expressed its desire for "national uniform standard procedures for determining the annual per-student costs of providing postsecondary education for students in attendance at various types and classes of institutions of higher education."

Because of the great interest in this subject and the potential significance for public policy of the search for national uniform cost standards, we asked Frederick E. Balderston, Professor of Business Administration at the University of California, Berkeley, to prepare the following paper on the problems involved in cost analysis of graduate education.

Difficulties in Cost Analysis of Graduate Education

Frederick E. Balderston

INTRODUCTION AND SUMMARY

Students, institutions, and providers of funds to universities are interested in cost indicators for a wide variety of decisions and policy questions concerning graduate education and associated research activities. Each type of decision requires adoption of a cost concept that is specifically appropriate for that decision, as well as information about the value, benefit, and quality of results forthcoming from the use of resources. A cost estimate based on a cost concept that is not the appropriate one for a particular decision gives misleading evidence for that decision.

Costs of a particular program of graduate education are affected by the *scale* of the program, the *methodologies of scholarship and modes of study* specific to that field, the *quality aspirations* for the program, and the *efficiency* with which resources are used. Most programs of graduate education also display substantial *jointness* with other aspects of university operation.

Graduate education, as conducted in American universities, is intertwined with:

1. basic and applied university research, both extramurally funded and institutionally supported;
2. undergraduate education through sharing of the same faculty and other institutional resources, through the involvement of graduate students in undergraduate instruction, and through the incorporation (after time lags) of research findings and graduate instructional materials in undergraduate courses and curricula;

3. "public service" obligations of universities, because some graduate students are involved in public service functions (e.g., medical residents with duties of patient care in hospitals) and because some research activities have significant public-service aspects.

Joint processes make for difficulties of cost analysis, as is well-known in the economics and accounting literature. Cost analysis for graduate education is thus an inherently complicated problem.

WHOSE COSTS, AND FOR WHAT DECISIONS?

Costs analyses differ in design and content depending on the breadth of view taken, the purpose for which cost magnitudes are to be estimated, and the time horizon contemplated for decisions or policy recommendations.

As we shall see, there are different kinds of decision problems for *financing* a program of graduate education in a given field. Different cost concepts and, consequently, different cost estimates, are needed for each of the types of decisions. Also, a particular university's cost pattern for a given program depends both on the manner in which that program is designed and on the nature of the linkages it has to other programs on the campus. As will also be discussed below, similar distinctions must be made if cost estimates are to be used as guides for the evaluation of the efficiency of graduate programs.

A Nation's Costs

The broadest issue is: What does graduate education (a type of program, or in total) cost a nation in the long run (a generation or two), and what proportion of society's efforts should be devoted to it? A student completing a graduate program has an expected career life of 30 to 40 years, in teaching, research, a practicing profession or (occasionally) a career only indirectly related to graduate preparation. A university constructs new buildings with an expected service life of 40 years or more. A nation such as the United States gains the fruits of new knowledge and perspective from the related research activities it supports over a time-horizon of a generation or more.

Seen in this light, graduate education has imputed costs and consequences that raise the deepest questions of what the purposes and priorities of the nation are and ought to be.

For this kind of cost analysis, it is important to estimate both operating and (annualized) capital costs of graduate education, and also to estimate these as real social costs, including the social "opportunity costs" of resources employed, going beyond and behind the estimates of money costs (to obtain estimates of true opportunity costs) and beyond the question of specific financing by individuals, institutions, or agencies to count up the totality of contributed resources, however these contributions are financed.

A Student's Attendance Costs

At the opposite end of the spectrum is the estimate, by or for an individual, of his cost of *attendance* in a graduate program. Someone who is deciding whether to begin a program of graduate study should be interested in this, as it often has a large bearing on the decision whether to start and the subsequent decisions whether to persist in the program. Before committing to graduate study, the prospective entrant can first estimate annual fees paid to the institution where he will study, the other cash outlays for living (the graduate student is almost always "emancipated" and has separate quarters from parental residence) and cash outlays specific to study (books, supplies, etc.). If the student knows how long the program will take him, he can estimate his *gross cash outlay* to complete it and, against this, offset his expected annual cash earnings (during the academic year and the summers), any fellowship or grant income, spouse's earnings, and gifts from parents and others. This gives him an estimate of *net cash outlay* to complete the program, to be financed from prior savings or by borrowing. Both outlay and income are subject to variances and contingencies (Will an assistantship or a fellowship be renewed? What if we have a baby?), and the time to complete is also subject to numerous risks, including academic failure, financial pressure, and simple variation in degree progress (especially, for doctoral students, the time to complete a dissertation).

Two elements of controversy about the proper calculation of the individual's cost forecast for graduate study are his *income and living standard foregone* during the process (the difference between what he can earn and how he lives while in graduate study and what he would have earned if not in graduate study). Foregone incomes surely figure in broad estimates of cost to society, but whether they also have a bearing on the prospective student's estimates at the time of decision to enter is debated.

The prospective student's estimate of total cost is of course affected by the probability of completion and the estimated number of years of study. For many programs, this has considerable variance (*assuming* actual completion of the degree). Also, as we have seen, the task of estimating includes attention to various contingent future events with more or less vaguely defined probabilities. Looking ahead, the prospective student faces what is called a "decision tree," with various branching points on both the outlay and the income aspects of his future interval of study. There are well-known methods of summing up the expected value over all paths of such a decision tree, but the hard part is obtaining the estimates of the cost and income magnitudes and of the probabilities of various events.

The prospective student could also compare the discounted pecuniary outlay cost of graduate study with (assuming successful completion of the program) the discounted value of the income differential for the subsequent career relative to what his or her stream of annual future incomes would be if he went directly to work without going through graduate study. This kind of investment calculation is seldom actually performed in detail by students as a basis for their decisions to enter graduate programs, and there are *other, nonpecuniary factors* which may indeed have controlling influence on the decision. In a very rough-cut way, however, students *often* try to think through their choices with some attention to the economic worth to them of graduate education (or the size of the net economic penalty), and economists have performed these kinds of calculations in studies of the "returns to education."[1]

Besides serving as some guide to personal decisions, these estimates of investment returns to education are a partial basis (and some believe, a dominant basis) for social decisions about the merits of investments in human capital and for determination of policies concerning what portion of costs should be borne by funding agencies, by institutions and by the individual student.

An Institution's Costs of Graduate Education Programs

From time to time, a university contemplates establishing a new graduate program. For this purpose, it is relevant to estimate, from the present initial base of faculty, library, building space and other capabilities, what are the likely long-range incremental commitments of costs and the long-range incremental sources of income and support from outside sources.

Only if this is done can the university make a reasoned planning choice, for the difference between long-range incremental costs and long-range support expectations is the amount that the university will have to find from general institutional funds to support the consequences of a decision to start the new program.

The new program will have start-up costs and transitional operating costs each year on the way to steady-state viability. Suppose that there is an

[1] See, for example, Gary Becker, *Human Capital* (N.Y., National Bureau of Economic Research, 1964); T. W. Schultz, *The Economic Value of Education Returns to Education, a Disaggregated Approach* (McGraw-Hill, 1973); and T. W. Schultz, Editor, "Investment in Education," Special Issue of the *Journal of Political Economy* (Volume 80, No. 3, Part II, May/June 1972).

estimated "critical mass" of the program (measured in total number of affiliated faculty, full-time equivalent (FTE) faculty allocated to the program, head-count and FTE students, other staff, and associated space and equipment) for steady-state viability. (Unfortunately, there are only primitive notions of what this viability requirement is in most fields of graduate study.) It would be helpful to compare the present base with the steady-state requirement. On the side of student enrollment, this would serve as an indicator of how much market draw the new program would have to attract, in relation to current and future enrollment demands in other fields. On the side of resources (including faculty positions) it would show how much expansion (or redirection of resources) the institution would have to finance from its own or external sources.

A second, and scarcely less important, cost issue is the transition from the present to steady-state viability. Very small graduate programs typically have high costs per student year, because the nucleus and start-up costs have to be borne but enrollment is small. A slow and deliberate transition over a period of many years, which is all that many universities feel they can afford, has the predictable consequence that unit costs are high, drawing power for students of high quality is poor (compared with other, established programs) and recognition of the program's academic quality is poor. At some risk, an institution can avoid some of these transition costs by a planned, rapid build-up to steady-state size.

Perhaps it is a commentary on the state of the management art in universities that this kind of simple planning exercise is often not done (especially by the proponents of a new program, who at the time of a decision to initiate want to show that, like pregnancy, the decision to begin can be painless and ever rather fun), and the comparison of different paths to viability is not considered at all.

There are radical differences in the costs of achieving steady-state viability for major graduate programs. Here are a few of the author's guesstimates in 1971 prices:

1. *Medical School* (175 faculty, medical undergraduates entering class of 130, with clinical residents and basic-science Ph.D.'s to keep the faculty happy and productive in medical research)
   Capital cost: $100 million, plus cost of teaching hospital
   Operating expenditures: $30 million/year plus hospital expense
2. *Law School* (100 faculty : 1000 total students)
   Capital cost (building and library): $7.5–12.5 million
   Operating expenditures: $4 million/year
3. *A physical or biological science field* (30 FTE allocated faculty, 180–240 FTE doctoral students)

Capital costs (building and equipment): $7.5–10 million
Operating expenditures: $1.75 million/year, excluding major extramurally funded research projects

4. *A social science field* (20 FTE allocated faculty, 160–200 FTE doctoral students)
Capital costs: $2.5 million, including $0.5 million for special library collection
Operating expenditures: $0.75 million/year, excluding major extramurally funded research.

To the presidential reader whose reaction is, "We want one of those, but we simply can't afford those costs," a reasonable rejoinder is, "Can you get credible proof that you have a way to obtain a viable program for less?"

Major universities that already have a wide span of graduate programs and undergraduate curricula face a different issue than that of estimating the cost of planned choices of new directions. Here are three of the interesting problems for program cost analysis in an ongoing situation:

1. Where are the university's resources now going (i.e., considering the total operating expenditures of the institution in a given year)? What amounts out of that total can be imputed to each program, including a segregated *cost rate* for each graduate program?
2. What should the *cost rate* be to provide needed improvements in specified graduate programs (especially, improvements of the sort that money can buy in the near term)?
3. What costs presently borne would be avoidable if specified programs were dropped, and over what time horizon would expenditure reductions be realizable?

The first of these questions is the sort that cost-simulation schemes such as the NCHEMS/WICHE Resource Requirements Prediction Model are intended to answer.[2]

The basic idea of this sort of cost imputation is to capture in a program classification the range of academic programs and levels of programs, obtain statistical indicators of major interactions among parts of the academic program span of the institution, assemble estimates of the resources employed and the students enrolled, by standard resource-input and student categories, and then run the model to obtain total direct costs, total costs, and cost per student for each academic program or major. The program itself contains allocation rules for dividing up various cost pools among their uses.

[2] See *Introduction to the Resource Requirements Prediction Model 1.6* and *Resource Requirements Prediction Model 1.6 Reports*, Technical reports 34A and 34B (Boulder, Colorado: National Center for Higher Education Management Systems, 1973).

This sort of cost-imputation has its limitations (particularly in the arbitrary treatment of allocations from cost pools and in the handling of the problems of jointness that were mentioned at the beginning of this chapter). Nevertheless, it is instructive to discover that costs per student year may vary between academic fields by as much as a factor of ten, that some undergraduate programs apparently cost more per student year than do some graduate programs, and that even *direct* costs per student year are subject to very large variations between fields in the same university. Such differentials are not necessarily bad, and in fact may be mainly rooted in real differences in the way in which academic work has to be conducted in different fields. However, the disclosure of differentials of such large magnitude often triggers good questions among those responsible for seeing to the effective use of resources.

Other approaches to program costing, essentially based on budget analysis and cost accounting techniques, have also been used to arrive at cost imputations for graduate programs. Powel and Lamson[3] did an exhaustive review and critique of these methods, and McCarthy and Deener[4] wrote a useful, brief commentary on the problem, based on Powel and Lamson.

It should be noted parenthetically that the usual methods of working from a university's data to arrive at a cost imputation for each graduate program provide a point estimate, for a fiscal year or other time period, of what total program costs or unit costs actually were. Such estimates are not necessarily what the economist wants as the elements of a firm's cost-function that relates total cost to total output of a good, for such a cost function presumes that for each possible output-level, the technology is known, the input-prices are known, and the inputs are combined to minimize costs for that output-rate. Each point on the cost function is an *efficient* point—costs could be higher if the production process is not optimized for that output rate, but they cannot be lower with the given technology and input prices. Quite apart from the other issues of accuracy, data definition, and allocation techniques for estimating graduate costs, it cannot be presumed that a cost estimate, when completed, is an efficient point. We return to this question below.

The second institutional question about costs is, what about the incremental cost of making improvements in a given program? Claims for improvement resources typically include (1) added faculty positions, to round out coverage of specialties in the field or to add essential intellectual strength; (2) fellowships and assistantships, to attract more and better graduate students; (3) equipment, library, and space allocations; and (4) research support, but for faculty and for advanced graduate students. If the program in question is presently small, this may simply mean that those who want more resources are seeking to move on an expansion path toward steady-state viability; but in view of the competition for resources, decision-makers at higher levels have to ask whether the key people in the program could make good use of more resources, if provided; that is, whether the claimed improvement of the program will materialize. They also have to decide whether the requests have sufficient priority to be met from resources available for allocation at the margin.

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[3] John H. Powel, Jr. and Robert D. Lamson, *Elements Related to the Determination of Costs and Benefits of Graduate Education* (Washington, D.C.: Council of Graduate Schools, 1972).

[4] Joseph L. McCarthy and David R. Deener, *The Costs and Benefits of Graduate Education: Commentary with Recommendations* (Washington, D.C.: Council of Graduate Schools, 1972).

The third institutional question is the following: What costs could be avoided if a specified graduate program were dropped? This painful question is now arising with some frequency in hard-pressed graduate institutions, and there are of course many other questions—of equity, academic policy, and appropriate mechanisms of decision—that outweigh cost considerations. Analysis usually demonstrates that immediate reductions of expenditures are small. Reallocation of clerical and administrative staff is relatively easy, but to reassign or vacate faculty positions—except those of the most junior staff—often takes time, measured in years rather than months, unless the university in question faces a genuine fiscal emergency and is ready to take the risk of setting aside tenure for that reason. On closure of a program, a university also has obligations to graduate students who are in the pipeline; if senior faculty leave for other positions and can shift their graduate candidates with them, the transition is easier and faster.

Costs Borne by Specific Funding Agencies

In addition to being entangled in joint production and joint output, many graduate programs and their associated research activities are put together with funding from multiple sources in addition to general institutional funds. Foundations, federal agencies and private donors may supply fellowships; research projects may be funded by any of numerous extramural sources with key faculty as principal investigators, and junior faculty and graduate students partly supported for their research and incomes from these projects. These funding agencies often wish to assure that funds awarded are used for the purpose agreed, which is something that adequate financial stewardship and grant administration by the university can cope with up to a point. But, as several components of funding are used to support intertwined activities, funding agencies can never be quite certain that they are getting what they think they are for their money.

GRADUATE PROGRAM COSTS: JOINTNESS WITH RESEARCH AND WITH UNDERGRADUATE INSTRUCTION

In most American universities, some faculty members perform only one functional activity and all of their salary costs can be assigned to that; but most faculty members do some undergraduate and some graduate teaching in courses; supervise some dissertation research; and perform some research of their own, with or without extramural funding. Methods of measuring the pattern of faculty effort include time-reporting by every faculty member each term by means of a simple accounting form;[5] in-depth interviews of a sample of faculty members to determine the time spent on numerous distinct activities *and* the mapping of these activities onto single or joint university "outputs;"[6] and work-sampling or diary-keeping for specified periods.[7]

All of these approaches involve self-reporting by faculty members. Their typical disclosure of a very long work-week and of a large amount of teaching time is regarded with skepticism by public budgetary authorities partly for that reason. But the problem is deeper: If a faculty member does less of one thing, what is he likely to do more of? One indication of complementarity is that graduate students usually seek out, for graduate courses and as supervisors of dissertation research, those well-known members of the department who are active in published research and who are most likely to have extramurally supported projects. The teaching of these faculty members is likely to be at the frontier of the subject; when the time comes for placement in academic employment, they have wide contacts and their recommendations carry weight; and they have budgetary resources to support dissertation candidates. It may seem odd that many of these key faculty members also share vigorously in undergraduate course teaching, an activity which almost surely competes at the time-margin with the more closely coupled activities of research and graduate teaching.

Salary costs of faculty may be funded partly from extramural grants—for full-time research in the summer months; sometimes, for research leave during part of the academic year with concomitant release from other departmental duties; and occassionally (as some major private universities have recently found was risky) a regular expectation that extramural grants would take care of a part of the faculty member's academic-year basic salary, reported as research time to the granting agency.

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[5] Such public universities as the University of Texas and Ohio State University have done this in order to report in prescribed ways to the state budgetary authorities.

[6] "Faculty Effort and Output," Report to the Regents of the University of California" (Office of the Vice President—Planning and Analysis, January 1970). This method has been amplified and refined in the recommended scheme of measurement published by the National Center for Higher Education Management Systems task force on Faculty Activity Analysis currently in progress.

[7] Gareth L. Williams, Tessa Blackstone, and David Metcalf, *An Academic Labor Market* (Elsevier Publishing Company, in preparation).

Can more of both graduate education and research be accomplished because they are performed in the same setting, and, more specifically, is the amount of graduate education likely to be increased if research funding is augmented while departmental funding for graduate instruction is held constant? The answer to this differs from field to field, but in those areas of scholarship where dissertation research requires supported outlays and where there is a close research relation between faculty supervisor and dissertation candidate, the answer is probably "yes."[8]

In scientific departments with research establishments that involve faculty, graduate students, other research and technical personnel, and significant amounts of space and equipment, Breneman found that graduate student places have to be rationed because of requirements of laboratory space, equipment access, and time for detailed faculty supervision.[9] He found that this produces incentives to screen entering graduate students carefully, start them early on research that will lead to a dissertation, monitor progress carefully, and keep the elapsed time to the degree as low as possible.

In such research establishments, one possible indicator that the size of research activity exceeds a minimum for academic viability might be the presence of an exceptionally high ratio of postdoctoral and professional researchers (not holding faculty appointment) to the number of graduate students in that field. Disciplines vary in the extent to which a year or two of postdoctoral research experience is a *de facto* necessity for the young academic and in the extent to which postdoctoral research costs are built into the resource base, so that comparisons of different fields in the same university would not be as indicative as would interuniversity comparisons in the same field. After some point, the presence of these nonfaculty, nongraduate-student researchers is likely to increase the flow of research results while having small marginal effects on the quantity or quality of graduate education.

If we examine the implications of reducing the amount of funded research in laboratory fields while seeking to hold graduate enrollment and quality of work constant, several effects can be foreseen. One is the selection of dissertation research topics that will not be resource-using; in some fields, this effectively debars the Ph.D. candidate from doing thesis work on mainstream topics. Another probable consequence is that, because money is not forthcoming for part-time employment of graduate students, more of them will seek other employment to support themselves prior to completion of the dissertation; the elapsed time to the degree will increase for many degree-winners and the risk of noncompletion will increase; and the reduced amount of cooperative involvement of the faculty supervisor and the graduate student will have adverse effects on the quality of research apprenticeship experienced by the graduate student.

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[8] David W. Breneman, "An Economic Theory of Ph.D. Production: The Case at Berkeley," Ford Foundation Program for Research in University Administration Paper P-8 (Berkeley: University of California, 1970); "The Ph.D. Production Function: The Case at Berkeley," Paper P-16 (Berkeley: University of California, 1970); "The Ph.D. Degree at Berkeley: Interviews, Placement and Recommendations," Paper P-17 (Berkeley: University of California, 1971).

[9] Breneman, Paper P-16, *op. cit.*

The above observations also bear on the question of competitive quality or reputation of graduate departments in a given field. Universities that are fortunate to have strong academic *cadres* for graduate study in a field also can expect that (1) their key faculty will compete successfully for research grants that are awarded on peer-group judgments of scientific merit; (2) their key faculty will attract exceptionally able graduate students and will face strong demands to provide places for postdoctoral scholars; and (3) the strong department will make intense demands for space and for support budgets from institutional funds to accompany the large-scale extramural funding and the robust doctoral program for which it is responsible. In this competitive *milieu*, the basic rule is—"Them as has, gits." The main variables relating to quality are all positively correlated with each other.

In most humanities fields and some social sciences, the main scholarly tradition is much more one of individual work, by both faculty member and dissertation candidate, than in the technology of graduate education presumed above. Major investments in specialized library collections may be required to support the work of specialists. The research performance of an individual scholar in these fields is a function mainly of his quality of mind and his energy and of the availability to him, at critical intervals in his work, of extended periods of uninterrupted time for reflection and writing. The scholar benefits from an atmosphere of stimulus and striving among his colleagues, and a good department in such a field has that atmosphere. The same general considerations of research productivity hold for dissertation candidates as for established scholars, with the added element that the faculty sponsor of a candidate can help him or her enormously by encouraging wise choice of a dissertation topic from the important problems of the field and finding ways to assist the candidate with the craft of scholarship and with gaining access to needed library materials and primary sources.

Jointness Between Graduate Education and Undergraduate Instruction

Does the presence together of graduate education and undergraduate instruction in universities enhance or inhibit the quality and intensity of undergraduate study, how does the presence of the graduate operation affect the costs of undergraduate instruction, and how does the presence of undergraduate instruction affect the institution's costs of offering graduate instruction? In other words, does the multiprocess, multiproduct university display fundamentally higher academic efficiency than the single-product undergraduate institution (and, one might add on the side of research, the single-product, free-standing research corporation or "think tank")?

The present author has explored conceptual issues of "Complementarity, Independence, and Substitution in University Resource Allocation and Operation."[10] In a recent paper, Stephen Dresch argues that when the cost relations between graduate education and undergraduate instruction are re-examined in the light of complementarities and contributions to undergraduate instruction (partly through the use of graduate students as part-time instructors at low prices), graduate education is much less subsidized at the margin than is generally supposed.[11]

There is little doubt that, at the margin of faculty time, research and graduate instruction compete with assignment to undergraduate instruction in universities, and that there is also competition between these activities at the budgeting margin for clerical support, library service, and various other inputs. It is also true that those immediately responsible for one of these activities usually feel that what they are in charge of is under–financed as compared with what they think they need to do a first-rate job. But that may be a matter of attempting a menu of operations that exceeds the boundaries of aggregate resource availability; and, while such a perception does impose frustrations, the possible relative starvation of undergraduate instruction in this competitive regime, where the aggregate may be underfinanced, is not really the issue. The issue is whether in their inherent design as multiprocess, multiproduct educational organizations, universities have avenues of economizing in undergraduate programs, *for given effective delivery of undergraduate education,* that are not available to purely undergraduate institutions.

To summarize, the total cost of a particular program of graduate education at a university is a function of the following:

1. the *scale* of that university's resource commitment in the field, the size of the graduate program itself, and the interrelations of that program with research and undergraduate programs in the same field and with other neighboring academic areas;
2. the *methodologies* of scholarship and the modes of graduate instruction and study that are specific to the field, and the standards of scholarship and style of work that are characteristics of it;

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[10] Frederick E. Balderston, "Complementarity, Independence and Substitution in University Resource Allocation and Operation," Ford Foundation Program for Research in University Administration, Paper P-39, (Berkeley: University of California, 1973).

[11] Stephen P. Dresch, *An Economic Perspective on the Evolution of Graduate Education*, (Washington, D.C.: National Board on Graduate Education, 1974).

3. the *quality* of the program, and the intensity of aspirations for quality improvement (the latter causing heavy transition costs from institutional sources if quality improvement is attempted on a crash basis);

4. the *efficiency* of use of resources, including (on a multiyear basis) the effectiveness of choice of a path of further development of the program.

EVIDENCE ABOUT GRADUATE EDUCATION COSTS

The "Gradcost Study" and the McCarthy–Deener study (both sponsored by the Council of Graduate Schools and both cited earlier in this paper) contain some empirical evidence concerning the range of cost per student year from field to field. Powel and Lamson had to hedge their use of such evidence very carefully, because of differences in the practices of institutions in assembling cost data, differences in definition, etc.

Attached are the key tables (Table S.1 and Table S.2) of comparative costs for master's and doctoral programs (reproduced from McCarthy–Deener, pp. 37–38).

To produce this table, Powel and Lamson adjusted cost data from a number of different studies by using a standard definition of the full-time equivalent student academic year. The estimated costs are direct instructional costs only. Many of the qualifications and reservations that need to be kept in mind in the examination of this evidence have been discussed earlier in this paper. What do the cost figures apparently show? Here are some comments:

1. The range from the two lowest to the two highest unit costs of every field is very wide: The high ones are usually as much as 300–400 percent of the low ones.

2. For both types of degrees, the laboratory sciences and engineering show the highest maximum entries. But their minimum entries are below the maxima of the humanities and social science fields.

3. Within each field, the range of unit costs for master's degree programs generally overlaps with that for doctoral programs.

4. The four cost studies which Powel and Lamson used as their source contained estimates for only a small proportion of the total number of programs of each type. Had there been an estimate of unit cost for every such program in each field, the range would almost certainly have been wider than is reported.

5. To the extent that research expenditures and organizations are important in association with graduate education (remembering our discussion of jointness) the above cost estimates may well understate the resources that have to be locally available to conduct graduate education, yet (remembering the importance that graduate students have in the conduct of academic research) the contribution of graduate students to institutional and social product may be substantial although adjustment is not made for it.

TABLE S.1 Available Estimates[a] of Ranges of Unit Costs—Masters Degree Programs (1970 Dollars/9 month FTE Student Year; Powel–Lamson, 246–247)

Discipline	Number of Programs Offered in U.S.[b]	Number of Program Cost Estimates Available	Ranges[c] of Unit Costs Direct Instruction	"Full"	Total
Humanities				For the few available studies presenting data by departments, the ratio of unit "Full Costs" (i.e., total costs exclusive of graduate student fellowships and assistantships and of separately budgeted research costs) to unit Direct Instructional Costs ranged from 1.3 to 1.9 (PL, 245).	Total Unit Costs may be estimated by multiplying Direct Instruction Unit Costs by 1.3 to 1.9 and then adding the unit costs of graduate student fellowships and assistantships and of separately budgeted research, as may be appropriate.
Classics	77	4	2000, 2000—2000, 2500		
English	425	19	600, 800—2300, 2500		
German Languages	111	14	700, 800—2600, 3600		
Philosophy	120	13	600, 600—4000, 6200		
Romance Languages	165	8	1000, 1100—1600, 1700		
Social Sciences					
Anthropology	72	10	600, 900—1700, 3200		
Business Admin.	262	19	400, 500—1600, 1800		
Economics	194	15	600, 600—1700, 2000		
Geography	101	16	300, 600—2900, 3400		
History	361	16	700, 700—1600, 1700		
Psychology	272	20	400, 500—1800, 7000		
Sociology	191	15	500, 500—1100, 1200		

Biological Sciences			
Botany	84	6	2000, 2300—3500, 3800
Zoology	98	6	2100, 2100—2400, 2600
Physical Sciences			
Astronomy	30	8	2200, 2400—6700, 9000
Chemistry	299	22	600, 1500—4500, 5000
Geology	120	12	1700, 2400—5400, 7100
Mathematics	372	22	600, 600—3300, 5500
Physics	256	20	400, 700—4500, 4800
Engineering			
Chemical Engrng.	118	12	2100, 2500—5500, 7100
Electrical Engrng.	150	12	1300, 1500—4000, 4800
Mechanical Engrng.	143	12	1400, 1800—4300, 6900

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[a] Available estimates arose from only four separate studies in most cases carried out at public colleges and universities.

[b] The basis used by Powel and Lamson for estimating the number of graduate programs offered in the United States in each discipline is described in detail in their paper (PL, 247).

[c] Cost ranges are presented in terms of the lowest, next to lowest, next to highest, and highest cost estimates. In our opinion, some of the figures giving the low ends of the ranges do not represent all of the elements even of the Direct Instructional Costs associated with a good quality graduate degree program.

SOURCE: McCarthy, Joseph L. and David R. Deener, *The Costs and Benefits of Graduate Education: A Commentary with Recommendations* (Washington, D.C.: Council of Graduate Schools, 1972). [Reprinted with the permission of the Council of Graduate Schools.]

TABLE S.2 **Available Estimates[a] of Ranges of Unit Costs—Doctors Degree Programs (1970 Dollars/9 month FTE Student Year; Powel–Lamson, 248–249)**

Discipline	Number of Programs Offered in U.S.[b]	Number of Program Cost Estimates Available	Ranges[c] of Unit Costs		
			Direct Instruction	"Full"	Total
Humanities					
Classics	41	4	3000, 3700—3700, 4600	For the few available studies presenting data by departments, the ratio of unit "Full Costs" (i.e., total costs exclusive of graduate student fellowships and assistantships and of separately budgeted research costs) to unit Direct Instructional Costs ranged from 1.3 to 2.6 (PL, 245).	Total Unit Costs may be estimated by multiplying Direct Instruction Unit Costs by 1.3 to 2.6 and then adding the unit costs of graduate student fellowships and assistantships and of separately budgeted research, as may be appropriate.
English	92	9	1100, 1300—2600, 3500		
German Languages	48	9	600, 800—1600, 2000		
Philosophy	65	8	1900, 2100—3300, 4100		
Romance Languages	65	9	1400, 1500—2600, 3400		
Social Sciences					
Anthropology	42	9	1600, 1800—3200, 3400		
Business Admin.	57	7	500, 1500—3800, 7700		
Economics	91	8	1300, 1900—3300, 3600		
Geography	34	6	2200, 2900—5600, 7700		
History	91	8	1200, 2200—3800, 5100		
Psychology	110	10	1100, 1700—2900, 7600		
Sociology	73	9	1600, 1600—4100, 4900		

Biological Sciences			
Botany	97	6	3300, 3900—6900, 7300
Zoology	95	6	3200, 3500—4700, 7200
Physical Sciences			
Astronomy	35	5	4000, 10,100—15,500, 15,700
Chemistry	125	13	1900, 2500—6200, 6400
Geology	67	8	4200, 4300—11,100, 13,900
Mathematics	102	11	1100, 1400—3600, 6200
Physics	113	[illegible]	1600, 2700—7600, 11,100
Engineering			
Chemical Engrng.	73	7	2500, 4600—8200, 9100
Electrical Engrng.	78	7	1700, 2800—5600, 5600
Mechanical Engrng.	71	6	2500, 3600—5700, 6900

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[a] Available estimates arose from only four separate studies in most cases carried out at public colleges and universities.

[b] The basis used by Powel and Lamson for estimating the number of graduate programs offered in the United States in each discipline is described in detail in their paper (PL, 249).

[c] Cost ranges are presented in terms of the lowest, next to lowest, next to highest, and highest cost estimates. In our opinion, some of the figures giving the low ends of the ranges do not represent all of the elements even of the Direct Instructional Costs associated with a good quality graduate degree program.

SOURCE: McCarthy, Joseph L. and David R. Deener, *The Costs and Benefits of Graduate Education: A Commentary with Recommendations* (Washington, D.C.: Council of Graduate Schools, 1972). [Reprinted with the permission of the Council of Graduate Schools.]

Powel and Lamson also performed some regression analysis, seeking to test the effects of program size and of program quality (as indicated by Roose–Andersen ratings) on unit costs. They found statistically significant higher costs in the laboratory sciences and engineering than in the others. Otherwise, they could not report statistically strong results, although there were apparently some scale economies and some mild indications of a positive association between program quality and unit costs.[12]

Existence of a wide spread in cost experience is confirmed by other types of analysis of college and university resource usage. The Carnegie Commission on Higher Education report, *More Effective Use of Resources,* discussed the wide variations that can be found in cost behavior and gave tabular evidence of large variations in student–faculty ratios for each type of institution.[13]

Daryl Carlson used an extensive data file on individual institutions to do an econometric study of costs and of the production relationships at the achievable efficient frontier of resource utilization.[14] Carlson found that variations in cost per student were partly the result of differences in enrollment mix and other defining characteristics of institutions. He also showed that there were significant distances between the average usage of each type of input and the "best-practice" usage, and that ". . . the ratio of the average cost per student to the frontier cost per student for institutions with comparable characteristics and enrollment mixes ranges from 1.42 to 2.20 across categories of institutions." [15]

Two broad inferences can be drawn for policymakers from this review of methods and evidence in the realm of cost analysis:

1. There is valid reason for concern about the effectiveness with which academic resources are combined and used. Many institutions could very probably do better than they have been doing.
2. There are also valid differences arising from the differing characteristics of academic fields, differing designs of programs within categories, and differences in the immediate situation and context of the individual institution, such that a single, uniform national standard of "permissible cost," or even a set of standards with one cost magnitude for each discipline, would do violence to the variety of academic programs in this very heterogeneous "industry."

[12] Powel and Lamson, *op. cit.*, pp. 245–255.

[13] Carnegie Commission on Higher Education, *More Effective Use of Resources* (Berkeley, Carnegie Commission, 1972). See Chapter 3, "The Behavior of Costs" and pp. 82–83 for the distribution of student–faculty ratios within each type of institution.

[14] Daryl Carlson, *The Production and Cost Behavior of Higher Education Institutions*, Ford Foundation Program for Research in University Administration, Report P-36 (Berkeley: University of California, 1972).

[15] Carlson, *op. cit.*, p. 169.

THE COST PER STUDENT YEAR VERSUS THE COST PER DEGREE GRANTED

It is possible to take the estimated cost per student year in each field and, by applying the statistics of persistence and dropout over the course of time and assuming that the student who dropped out is an unrequited investment, to calculate the effective institutional cost per degree granted. The present author[16] discussed this sort of approach to the determination of effective cost of getting the final results of an educational process.

Because attrition rates are often much higher in programs that have low costs per student year than in some of the high student-cost-per-year programs, the net cost per degree granted is sometimes lower in the latter. There is of course a serious question about the validity of the assumption that the student who drops out of a program before receiving a degree has failed to achieve anything. The focus on effective cost per degree granted could be of interest, however, to institutional administrators who, by using this as a criterion of review and even of budgeting, could thereby stimulate graduate departments not merely to amass *enrollment* but also to pay close attention to final achievement of the degree. Criticisms of the details of curriculum and organization of graduate study imply the usefulness of such a change of focus.[17]

Such figures are also of potential interest to those who are trying to estimate what subsidy costs the states or the federal government may need to bear in order to assure that a particular number of fully trained professionals in a field would be forthcoming. The pertinent issue for this purpose is not the cost per enrolled student year but the cost per degree.

TRENDS IN COSTS OVER TIME

June O'Neill's basic work on long-term trends in resources used for education and Earl Cheit's study *The New Depression in Higher Education*, though not solely focused on the costs of graduate education, serve as excellent background for the assessment of trends.[18]

The present author explored in two papers some special aspects of cost trend and gave estimates of trends in particular components of university expenditure.[19]

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[16] Frederick E. Balderston, *Thinking About the Outputs of Higher Education*, Ford Foundation Program for Research in University Administration, Paper P-5 (Berkeley: University of California, 1970).

[17] Breneman, Paper P-17, *op. cit.*

[18] June O'Neill, *Resource Use in Higher Education: Trends in Output and Inputs, 1930–1967* (Berkeley: Carnegie Commission, 1971); Earl F. Cheit, *The New Depression in Higher Education* (McGraw-Hill, 1971).

It is unnecessary to summarize these studies of cost trend here. What should be emphasized, however, is that institutional plans for fiscal and academic development should take account of a variety of both institutional and market factors that influence cost magnitudes over time; there has not been sufficient attention to these in the past, as the title of the first of the cited papers indicates. Also, if federal policy alternatives that entail the use of cost analyses and cost standards are designed, these too should take into account trends as well as present estimates.

CONCLUDING COMMENTS

The appropriate cost concept should be used for each kind of decision about graduate education: long-range, social costs for national policy decisions; one of several forms of investment–cost analysis for prospective student's decision about entering a graduate program; and the appropriate cost approach for each of the graduate institution's several types of decisions about graduate programs. For all of these cases, costs are important, but are only part of the equation.

The problems of institutional cost analysis for graduate education are inherently complicated because of the jointness of processes and outputs. This factor, together with the wide variety of scales and technologies of these educational activities and the lack of standard definitions and measures, gives rise to varying estimates of costs even according to a given cost-definition approach. In addition, estimated costs can differ between institutions for the same activity because of differentials in the efficiency with which resources are combined. In the present state of the art, it is generally not possible to show conclusively what the reasons are for quantitative divergencies between cost estimates.

As we have seen, the research pattern, the pattern of graduate education, and the pattern of undergraduate instruction in a given field are all linked together. Also, the reasonableness of the cost pattern needs to be judged against both the quantity and quality of the results in research attainment and graduate instruction. For these reasons, evaluation of a program's efficiency needs the attention not only of expert cost analysts but also of scholarly experts in the field itself.

[19] Frederick E. Balderston, "Varieties of Financial Critis," in Logan Wilson and Olive Mills, eds., *Universal Higher Education*, (Washington, D.C.: American Council on Education, 1972), also published as Ford Research Report P-29; and Frederick E. Balderston, "Cost Analysis in Higher Education," Ford Research Report P-33 (Berkeley: University of California, 1972).

If federal agencies seek to establish cost standards for graduate education as a basis for national planning decisions or in conjunction with the establishment of financing and cost-reimbursement formulas, appropriate cost concepts should be used for different purposes, different cost magnitudes or ranges will need to be developed for different types and technologies of graduate programs, and sound procedures for adjusting costs with trends in input prices will be needed.

Appendix

Statistical Tables

TABLE A.1 Federal Expenditures for Research and Development at Universities and Colleges by Character of Work, 1963–1972

	Federal R&D Expenditures, $ million							
	Total		Basic Research		Applied Research		Development	
Fiscal Year	current	constant[a]	current	constant[a]	current	constant[a]	current	constant[a]
1963	760	709	610	569	128	119	22	21
1964	916	842	767	703	127	117	22	20
1965	1,073	968	879	793	157	142	37	33
1966	1,262	1,108	1,009	885	194	170	59	52
1967	1,409	1,198	1,124	956	222	189	63	54
1968	1,572	1,285	1,268	1,037	241	197	63	52
1969	1,600	1,248	1,275	994	245	191	80	62
1970	1,658	1,226	1,288	952	266	197	104	77
1971(prelim.)	1,724	1,218	1,349	953	276	195	99	70
1972(est.)	1,788	1,224	1,409	964	286	196	93	64

NOTE: It should be pointed out that the distribution of federal funds shown here and in subsequent tables is based on university reporting and university definitions of basic and applied research and development. Reports based on federal agency reporting show a larger share of federal funds going to applied research. See National Science Foundation, *Federal Funds for Research, Development and Other Scientific Activities* (Washington, D.C.: U.S. Government Printing Office, 1972.)

[a] 1958 constant dollars; GNP price deflator was used to convert current to constant dollars.

SOURCE: National Science Foundation, *National Patterns of R & D Resources, 1953–1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.2 University and College Expenditures of Their Own Funds for Research and Development at Universities and Colleges by Character of Work, 1963–1972

Fiscal Year	University and College R&D Expenditures, $ million							
	Total		Basic Research		Applied Research		Development	
	current	constant[a]	current	constant[a]	current	constant[a]	current	constant[a]
1963	485	453	343	320	128	119	14	13
1964	555	510	402	369	139	128	14	13
1965	615	555	445	401	155	140	15	14
1966	673	591	494	434	161	141	18	16
1967	753	640	551	469	182	155	20	17
1968	841	688	621	509	198	162	22	18
1969	900	702	678	529	200	156	22	17
1970	970	717	747	552	200	148	23	17
1971(prelim.)	1,099	776	851	601	228	161	20	14
1972(est.)	1,226	839	954	653	255	175	17	12

[a] 1958 constant dollars; GNP price deflator used to convert current to constant dollars.

SOURCE: National Science Foundation, *National Patterns of R & D Resources, 1953–1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.3 Summary of Basic Research Expenditures at Universities and Colleges, 1963–1972

Fiscal Year	Total Basic Research Expenditures,[a] $ million[b]	Federal Expenditures $ million[b]	Federal Expenditures %	University Expenditures (Own Funds) $ million[b]	University Expenditures (Own Funds) %
1963	967	569	58.8	320	33.1
1964	1,159	705	60.8	369	31.8
1965	1,280	793	62.0	401	31.3
1966	1,405	885	63.0	434	30.9
1967	1,518	956	63.0	469	30.9
1968	1,644	1,037	63.1	509	31.0
1969	1,628	994	61.1	529	32.5
1970	1,616	952	58.9	552	34.2
1971(prelim.)	1,670	953	57.1	601	36.0
1972(est.)	1,740	964	55.4	653	37.5
Percent Change					
1963–1968	+70.0	+82.2		+59.1	
1968–1972	+ 5.8	− 7.0		+28.1	

[a] Federal and universities own contributions do not sum to total since industry and "other nonprofit institutions" contributions to university basic research, which are small and comprise a fairly constant share, are not included here.

[b] 1958 constant dollars; GNP price deflator was used to convert current to constant dollars.

SOURCE: National Science Foundation, *National Patterns of R & D Resources, 1953–1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.4 Federal Obligations for Research and Development to University and College R&D by Selected Agency, 1963–1972[b]

Fiscal Year	Federal R & D Obligations, $ million[a]						
	Total	AEC	Dept. of Defense	HEW	NASA	NSF	Natl. Endow. Humanities[c]
1963	774.0	63.7	203.4	310.6	55.8	97.6	
1964	896.3	64.8	237.1	366.7	71.8	106.4	
1965	987.7	67.5	241.7	398.6	90.7	125.6	
1966	1,098.8	73.0	244.0	445.2	94.3	168.9	
1967	1,106.6	76.3	224.6	473.7	92.7	144.7	0.8
1968	1,143.3	83.2	198.8	506.2	103.1	153.5	0.6
1969	1,150.3	80.4	217.4	520.4	95.4	149.4	0.7
1970	1,069.7	75.0	196.3	454.7	94.2	148.8	0.9
1971	1,095.6	67.7	175.8	491.3	90.7	153.2	1.0
1972	1,268.3	59.4	166.9	601.8	76.9	229.1	2.5

[a] 1958 constant dollars; GNP price deflator was used to convert current to constant dollars.

[b] Because agency figures are available only as obligations, the total R & D figures presented here represent obligations rather than expenditures and therefore are not comparable with R & D statistics cited elsewhere in this report. The total R & D column in this table includes obligations to all federal agencies.

[c] These figures not included in total.

SOURCE: National Science Foundation (CASE), *Federal Support to Universities, Colleges and Selected Nonprofit Institutions, FY 71* (Washington, D.C.: U.S. Government Printing Office, 1973), and NSF tabulations for FY 1972; National Endowment for the Humanities, unpublished data.

TABLE A.5 Current Expenditures for Research and Development in Universities and Colleges, by Character of Work, 1963–1973

Fiscal Year	R & D Expenditures, $ million Total, $ million	Basic Research $ million	 %	Applied Research $ million	 %	Development $ million	 %
1963[a]	1,359	1,036	76.2	283	20.8	40	2.9
1964	1,595	1,251	79.1	294	18.4	40	2.5
1965[a]	1,822	1,419	77.9	346	19.0	57	3.1
1966	2,085	1,601	76.8	400	19.2	84	4.0
1967[a]	2,329	1,795	77.1	444	19.1	90	3.9
1968	2,599	2,011	77.4	492	18.9	96	3.7
1969[a]	2,705	2,087	77.2	501	18.5	117	4.3
1970	2,856	2,185	76.5	527	18.4	144	5.0
1971(prelim.)[a]	3,070	2,365	77.0	570	18.6	135	4.4
1972(est.)	3,280	2,542	77.5	612	18.7	126	3.8
1973(est.)	3,425	2,615	76.4	665	19.4	145	4.2

[a] Estimates derived from related information; no sector survey was conducted for this year.

SOURCE: National Science Foundation, *National Patterns of R & D Resources, 1953–1973* Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.6 Federal and University R&D Expenditures as a Percent of GNP, 1955–1972

Fiscal Year	Total Federal		Total University and College		Federal Funds to Universities and Colleges		University and College Self-Support Funds	
	Amount, $ billion	% of GNP	Amount, $ billion	% of GNP	Amount, $ billion	% of GNP	Amount, $ billion	% of GNP
1955	3.509	0.88	0.409	0.10	0.169	0.04	0.185	0.05
1960	8.752	1.74	0.825	0.16	0.405	0.08	0.328	0.07
1963	11.219	1.90	1.359	0.23	0.760	0.13	0.485	0.08
1964	12.553	1.98	1.595	0.25	0.916	0.14	0.555	0.09
1965	13.033	1.90	1.822	0.27	1.073	0.16	0.615	0.09
1966	13.990	1.87	2.085	0.28	1.262	0.17	0.673	0.09
1967	14.420	1.82	2.329	0.29	1.409	0.18	0.753	0.09
1968	14.952	1.73	2.599	0.30	1.572	0.18	0.841	0.10
1969	14.917	1.60	2.705	0.29	1.600	0.17	0.900	0.10
1970	14.775	1.51	2.856	0.29	1.658	0.17	0.970	0.10
1971	14.996	1.42	3.070	0.29	1.724	0.16	1.099	0.10
1972	15.923	1.38	3.280	0.28	1.788	0.15	1.226	0.11

SOURCE: National Science Foundation, *National Patterns of R & D Resources, 1953–1973* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.7 Federal Fellowships, Traineeships, and Training Grants

	Fellowships and Traineeships[a]		NIH Training Grants[b]	
Fiscal Year	No. Students, Thousands	Amount, $ million	No. Students, Thousands	Amount, $ million
1963	15.6	80.7	NA	NA
1964	20.4	106.1	NA	NA
1965	26.4	140.4	NA	NA
1966	40.0	213.0	15.6	120.6
1967	51.3	257.6	15.5	131.3
1968	51.4	262.1	16.3	132.5
1969	42.5	222.9	15.8	139.3
1970	33.2	162.3	15.2	128.5
1971	29.0	137.3	15.0	129.7
1972	24.8	113.9	14.5	136.9

[a] Only predoctoral students. Amount includes cost-of-education allowance.

[b] Both predoctoral and postdoctoral, full-time and part-time students; excludes Bureau of Health Manpower Education, Division of Research Resources, NIMH and General Research Support; includes National Library of Medicine; amount includes both institutional and trainee costs.

SOURCE: Federal Interagency Committee on Education (FICE), *Report of Federal Predoctoral Student Support*, Part I 1970 (for fellowships and traineeships); NIH/OADPPE, Issue Paper on the Training Programs of the Institutes of the National Institutes of Health, Part I, October 1970, p. 44; FICE data on predoctoral Fellowships and Traineeships, 1970–1972, unpublished; and NIH/SAB, IMPAC System, "TAR" Reports (for NIH Training Grants).

TABLE A.8 Graduate Student Participation in USOE Loan and College Work–Study Programs, 1963–1972

Fiscal Year	National Direct Student Loans[a,b]		Guaranteed Student Loans[a]			College Work–Study Programs[a,c]	
	No. Students, Thousands	Federal Capital Component, $ million	No. Approvals, Thousands	Amount Borrowed, $ million	Federal Interest Payments, $ million	No. Students, Thousands	Amount, $ million
1963	13.0	5.4					
1964	14.8	6.5					
1965	19.2	7.8				4.6	2.2
1966	22.7	10.8	4.4	7.0	0.0	11.0	4.0
1967	23.7	10.6	29.7	22.4	1.0	12.0	5.4
1968	25.7	10.7	46.4	39.2	2.8	14.1	5.4
1969	27.4	11.0	70.9	61.8	4.4	15.4	5.7
1970	27.1	11.3	82.9	75.6	9.3	17.0	5.9
1971	33.7	13.6	97.3	94.0	13.3	24.0	9.5
1972	36.9	17.2	113.1	117.1	17.8	NA	10.9

[a] Since a constant percentage was used to determine the graduate component indicated here, the figures do not reflect changes (if any) in percent of graduate participation in program.

[b] Figures for federal capital component (FCC) do not accurately reflect the actual level of university loan potential since universities can use repaid loan monies to finance additional loans.

[c] Amount only applies to 80 percent federal share.

SOURCE: U.S. Department of Health, Education and Welfare, Office of Education, *Factbook* (Washington, D.C.: Bureau of Higher Education, 1973).

TABLE A.9 G.I. Bill Expenditures for Graduate Students[a]

Fiscal Year	No. Students	Amount, $ million
1967	NA	NA
1968	NA	NA
1969	99,314	81.2
1970	122,688	120.4
1971	146,092	177.7
1972	170,359	210.0

[a] Includes veterans and servicemen. Includes money students would spend for tuition and fees. Data do not include graduate school support for dependents and wives and children. Amounts are derived from VA total direct benefits costs. The amounts listed here for graduate students are projected from the proportion of graduate students receiving G.I. benefits. Since graduate students generally receive higher benefits due to a larger average number of dependents (and, hence, allowances), the graduate amounts probably underestimate the actual payments to graduate students.

SOURCE: Veteran's Administration.

TABLE A.10 Federal Cost-of-Education Allowances and Training Grant Supplements, 1963–1972[a]

Fiscal Year	Cost-of-Education Allowances, $ million		
	Fellowships and Traineeships	Training Grant Tuition	Training Grant Supplements,[b] $ million
1963	36.3	NA	NA
1964	47.7	NA	NA
1965	63.2	NA	NA
1966	95.9	5.8	68.9
1967	115.9	6.6	74.6
1968	117.9	7.7	70.2
1969	100.3	9.0	75.5
1970	73.0	9.9	62.8
1971	61.8	11.1	61.9
1972	51.2	11.7	69.3

[a] Included in amounts for fellowships and traineeships and training grants in Table A.7.

[b] Estimate based on 45 percent institutional component.

SOURCE: FICE, *Report on Federal Predoctoral Student Support*, Part I, 1970 (for fellowships and traineeships); NIH/OADPPE, Issue Paper on the Training Programs of the Institutes of the National Institutes of Health, Part I, October 1970, p. 44; FICE data on predoctoral Fellowships and Traineeships, 1970–1972, unpublished; and NIH/SAB, IMPAC System, "TAR" Reports (for training grants).

TABLE A.11 Federal Obligations for General Science Support, 1963–1973

	Federal General Science Support, $ million			
Fiscal Year	NSF Institutional Grants	NSF University Science Development Program[a]	NIH General Research Support[b]	Bur. Health Manpower Ed. Formula Grants to Public Health Schools
1963	7.6		23.9	NA
1964	11.4		26.0	NA
1965	11.4	27.4	33.5	2.5
1966	14.5	38.7	34.2	3.5
1967	15.2	37.6	39.6	3.8
1968	14.2	41.6	45.9	4.0
1969	[c]	31.7	45.4	4.6
1970	14.5	26.4	43.0	4.6
1971	14.5	19.9	40.2	5.0
1972	12.0	9.0	40.7	5.3
1973	8.0	0.0	20.1	[d]

[a] Includes Departmental Science Development Program.

[b] Includes General Research Support Grants, Health Sciences Advancement Awards, and Biomedical Sciences Support Grants.

[c] No funds listed this year because of change in allocation period.

[d] Figure not available.

SOURCE: National Science Foundation (CASE), and Bureau of Health Manpower Education, and Office of Management and Budget, *1973 Catalogue of Federal Domestic Assistance* (Washington, D.C.: U.S. Government Printing Office, 1973).

TABLE A.12 Federal Obligations for Facilities Support, 1963–1972

	Federal Support for Facilities, $ million	
Fiscal Year	R & D Plant	USOE Graduate Facility Construction Grants
1963	105.9	
1964	100.8	
1965	126.2	60.0
1966	114.8	60.0
1967	111.3	60.0
1968	96.1	34.2
1969	54.5	25.6
1970	44.8	0.0
1971	29.9	0.0
1972	36.9	0.0

SOURCE: R & D Plant: National Science Foundation (CASE); OE Construction Grants: Department of Health, Education and Welfare, Office of Education, *Factbook*, *op. cit.*

TABLE A.13 Federal Funds to Universities and Colleges by Program and Type of Support, Fiscal Years 1968 and 1972

Category	Federal Funds, FY 1968, $ million				Federal Funds, FY 1972, $ million			
	Student Support	Research Support	Institutional Support	Total	Student Support	Research Support	Institutional Support	Total
Fellowships and Traineeships	262.1		[a]	262.1	113.9		[a]	113.9
Training Grants	62.3[b]		70.2[c]	132.5	67.6[b]		69.3[c]	136.9
Work–Study (CWSP)	5.4			5.4	10.9			10.9
G.I. Benefits	60.3[d]			60.3	210.0			210.0
Research and Development		1,572.0[e]		1,572.0		1,788.0[e]	67.0	1,788.0
General Science Support			105.7	105.7				67.0
Loans:				13.5				35.0
Direct Student Loans (NDSL)	10.7				17.2			
Guaranteed Student Loans (GSL)	2.8				17.8			

Capital				130.3				36.9
R&D Plant			96.1				36.9	
Office of Education Construction Grants			34.2					
TOTAL	403.6	1,572.0	306.2	2,281.8	437.4	1,788.0	173.2	2,398.6

[a] Cost-of-education allowances included in the student support figure (for explanation, see footnote 10, p. 21).

[b] Includes both predoctoral and postdoctoral support.

[c] Tuition payments included in the student support figure.

[d] Estimate: VA data not available for graduate student component in 1968.

[e] Research assistantships included in this figure.

[f] GNP price deflator used to convert current to constant dollars.

SOURCE: Tables A.1 - A.12

	Fiscal Year Totals in 1958 Constant Dollars[f]			
	Student Support	Research Support	Institutional Support	Total
Total 1968	330.0	1,285.4	250.4	1,865.7
Total 1972	299.4	1,223.8	118.5	1,641.8
Percent Change, 1968–1972	−9.3%	−4.8%	−52.7%	−12.0%

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